Current Science

Vol. XVIII] FEBRUARY 1949 [No. 2

	Page
A Modern Drug Industry for India	31
Quality in Scientific Research Sir T. S. Venkatraman	32
The Asian Regional Commission of the International Meteorological Organisation	33
The Micromanipulator. S. L. Schouten	34
Bee Research Stations for India. A. S. Srivastava and M. Sreenivasaya	36
New Annual Reviews	38
Sir C. V. Raman	38
Modern Trends in Systematics	39
Mathematical Procedure in Statistical Theory	40
Improvement of Agricultural Statistics	40
Letters to the Editor	41
Research Information Service	53
Reviews	54
Fugitive Molecules, S. V. Anantakrishnan	57
Science Notes and News	59

A MODERN DRUG INDUSTRY FOR INDIA

THE decision of the Government of the Indian Dominion to start the production of an essential group of modern drugs—antibiotics, antimalarials and sulphas—at an estimated capital cost of two crores and a half, represents one of the most enlightened and progressive measures adopted by the National Government. The venture is a welcome contribution to the establishment of a drug industry on modern lines.

Major-General S. S. Sokhey, well known not only for his brilliant contributions to chemotherapy but also for his inspiring leadership in the creation of an active, contented, well disciplined and enduring school of research at the Haffkine Institute, Bombay, we learn, has been largely responsible for conceiving the idea and convincing the Government of the necessity for launching upon this enterprise.

In conformity with the recent policy of the Government of India to requisition expert assistance and advice from foreign firms in the matter of establishing industries in this country, a reputed Swedish firm, according to the press reports, has been invited to tender technical advice in the design and construction of the factory.

The production as planned, is expected to take care of nearly three-fourths of the major illnesses prevalent in India and effect a substantial saving (Rs. 2·25 crores per annum) in hard currency since most of these drugs are, at the moment, being imported from the U.S.A.

We are not quite happy about the disconcerting but nevertheless inevitable time lag —the long three-year period—which is said to be necessary for starting the production of these drugs. Considering the phenomenally rapid advances which are being made in the field of chemotherapy, there is the risk of the drugs now proposed to be manufactured being superseded by superior specifics, more potent, less toxic and less expensive to manufacture. Such risks one has to face in a competitive world, but they could be considerably minimised by a careful selection of plant and equipment, thoughtfully designed and fabricated to secure adequate flexibility so that the same manufacturing machinery could be harnessed for making other drugs. In the present instance, the plants contemplated to be installed, we hope, possess this merit.

The drugs now proposed to be produced are of vital significance to the nation and in the event of a war, these plants need adequate protection. From this point of view many may doubt the wisdom of locating the factory at Bombay, considering the imminent vulnerability of the metropolis. It would not be difficult to suggest other alternative sites for the location, *e.g.*, Bangalore, offering greater attractions for the industry to flourish and expand. We hope and trust that the organisers of this vital industry will give due consideration to this aspect of the problem.

We look upon this State enterprise as a national asset, not merely because of the means it provides for attaining a state of self-sufficiency with respect to these essential drugs, but on account of the long-range benefits which the venture could be made to confer on the country's drug research and industry, if the industry is well planned with scientific vision and technical foresight.

QUALITY IN SCIENTIFIC RESEARCH

YOUR January issue opens with a leader "Quality in Scientific Research" basing your comments on the recent speech of our outspoken Prime Minister at the Indian Science Institute, Bangalore. He is reported to have stated that research output in our country is not commensurate with the monies expended and with the wealth of research material and human talent available in the country. You lay the blame at the door of what you call the absence of "research climate". Below are indicated certain other causes for the dearth complained of.

With few honourable exceptions the spirit of wholehearted one-pointed continued devotion to research is lacking in many of our scientists. The reasons are partly social: the young enthusiast finds himself saddled with domestic and social commitments at a time when research should occupy his sole attention. Often so-called adminjstrative needs pick him out of his line and place him elsewhere and this breaks the continuity and enthusiasm of the researcher.

Apparently because the spirit of modern scientific research is somewhat recent in the country, many of our scientists show a love for power and administration, both of which are inimical to true research. A brilliant agricultural scientist held sway over one of our important institutes for about a year and he was able to cut down routine administrative work of the directorate by a well-planned method of decentralization in the matter of control. Others who occupied the same position—both European and Indian—showed a regrettable tendency to gather more administrative control than necessary. Ultimately, the Government red tape with its files and unending back papers proved so stiffling that he decided to quit. During his regime the scientists under him enjoyed a freedom they never had before or after.

Our scientists would do well to rid themselves of the mania for control and power to produce.

The present science departments have been modelled on the revenue-collecting departments with their graded array of heads, deputies, and assistants in descending order with great differences in emoluments. This difference in emoluments is often interpreted as connoting parallel differences in research talent which is wrong. We have not yet learned to appreciate and give the proper position to scientific talent.

In the past, the scientific services in the country lost many useful and devoted votaries because of the allurements held out by administrative positions carrying higher status and better emoluments. Science departments should learn to appreciate and hunt for research talent wherever found. In the future set up there should be no need for a researcher to give up his line of work and get lost in administrative nullity to improve his position. Scientific talents need to be paid on a par with administrative ability and within the science department itself the differences between pay scales should be lessened. I have very intimate knowledge of one agricultural researcher who had to give up higher emoluments in a different line of work and at a different place to enable him to produce tangible results. In this case, the individual lost but the country gained immensely.

T. S. VENKATRAMAN.

THE ASIAN REGIONAL COMMISSION OF THE INTERNATIONAL METEOROLOGICAL ORGANISATION

IT is a matter for genuine gratification that the Capital city of Free India is becoming the venue for the meetings of many International Conferences. In the first Asian Regional Commission of the International Meteorological Organisation which held its session at New Delhi from the 10th to the 20th November 1948, India played a leading part. 13 Member States including the U.S.S.R. as well as observers of the U.K., the U.S.A. and the I.C.A.O. took part in the proceedings.

The Prime Minister of India who opened the session on the 10th November, rightly stressed the importance of international co-operation in Meteorology as follows :—

".....So it is a good thing that we take advantage of all these opportunities for international co-operation, not only because it is good in their particular field of activity but because they affect the larger field of human relations in the world and make people realise that after all the world is being carried on today by a great measure of international co-operation. In this context the communications system becomes more and more international and so many other branches of Science can only progress internationally.

Therefore, I welcome all the delegates who have come here and I hope that your labours will bear fruit in this particular branch of Science which is so important for human welfare as well as in the larger field of human relations."

The Director-General of the Indian Meteorological Service was elected as President and the Chiefs of the U.S.S.R. and the Netherland East Indies Weather Services were elected as the two Vice-Presidents.

The Commission appointed *ad hoc* sub-committees to go into the following very important problems of Synoptic Meteorology in the Asian Region,—

1. Net-work of surface, upper air, radio-electric, etc., observatories.
2. Tele-communications and Broadcasts.
3. Codes and Units.
4. Marine Meteorology.
5. Use of Counting Machines for Meteorological purposes.

These sub-committees some of which were presided over by members of the Indian Meteorological Service concluded their valuable work during the session and produced workable solutions of the many problems raised and agreed plans for observational net-work, inter-regional and national meteorological broadcasts, procedure relating to codes and units, etc. The Conference held 18 plenary sessions to discuss the 25 items on the agenda and passed 45 resolutions and recommendations.

The labours of the Commission have paved the way for increased co-ordination and co-operation in the field of Meteorology. It is essential that we should have the maximum co-operation and understanding with our neighbour countries for the successful prediction of weather for the

benefit of the Indian farmer, aviator, engineer and the public at large.

Apart from the problems of organisation, procedure, communication, etc., referred to above, the Commission also considered some of the important research aspects of pure and applied Meteorology. In the field of Agricultural Meteorology the Indian workers under the Director of Agricultural Meteorology at Poona have played a leading role and it is pleasing to note that the Indian Crop-Weather Scheme has been adapted for international use by the Commission. A permanent Sub-Committee on Agricultural Meteorology, with the Director of Agricultural Meteorology, Poona (India), as Chairman, has been constituted for the Asian Region for developing and co-ordinating the work on this subject in the various countries of Asia.

Another permanent Sub-Committee on Hydrology, a subject of such vast importance for India where many multi-purpose irrigation schemes are under way, was also constituted.

It is obvious that these meetings at Delhi have been very fruitful and we congratulate both the Government of India and its Meteorological Department for the important role they have played in furthering the cause of Meteorology in the service of the Asian Region.

THE MICROMANIPULATOR

DR. S. L. SCHOUTEN

(Hygienisches Institute, University of Utrecht)

EARLY in February 1948, I had the pleasure of giving to Prof. M. Sreenivasaya during his stay in my Laboratory, a comprehensive demonstration of the Micromanipulator technique and its applications to problems in bacteriology and cellular physiology. On this occasion he suggested that I should contribute a note on this subject to *Current Science*; the following article has been written in response to his kind request.

The introduction of the gelatine medium by Robert Koch, represents one of the epochal landmarks in the development of bacteriological technique and has been responsible for the phenomenal advances in microbiological research during the past sixty years. This we certainly owe to the simplicity, ease and elegance of what has now come to be known as "plating method". The clarity of the medium facilitates the unmistakable location of microbes and the development of colonies as a result of their growth. No wonder that the method has remained unchallenged and is universally employed as a routine in bacteriological research.

Many workers, however, unwilling to confine themselves to routine investigation, observed that this method had certain serious limitations. When plating river water, we may be justified in assuming that by vigorous stirring of the molten nutrient medium, the individual cells would be completely separated, and the resulting colonies developed in the petri-dish, would represent integrally pure cultures. In the case of slimy material, however, *e.g.*, pus, blood, fæces, filthy ditch water, this assumption would not be justified. In such samples the cells adhere together, so that it is usually extremely difficult to separate them by stirring. We encounter the same difficulty with dermatomycoses. Even after pulverising with quartz powder one finds the cells adhering together in great numbers.

The investigator is often confronted with a mixture of different bacilli, from which he is obliged to isolate and examine one of them in pure culture. The "plating method" does not give him any reliable result; none of the colonies in the plate would be representative of the species he is seeking. This difficulty is experienced by all workers. Plating—I might say—is a blind method. An unknown quantity of unknown species is plated, but you never know which of them develop, neither the way of developing (only think of the lag-time!) nor the antagonistic influence of the different associates. From bacilli, found in fæces, it is often found that only one per cent. of them develop.

The inherent drawbacks which characterise gelatine or agar-agar affect the development of certain organisms, *e.g.*, nitrifying bacteria, but such organisms are fortunately few and occur only rarely. But what is of real importance is described in the next para.

The basis of all biological work consists in the integrity of the individual. In problems of heredity, in determining vari-

ability of a given strain, the experimenter has to carefully select his organisms individually. Should such a selection be not possible, scientific research would not be considered unimpeachable. In microbiology, selection and isolation of individual cells was considered impossible and till the end of the preceding century, investigators had reconciled themselves to this state of affairs. How could it be possible to experiment with individual cells of bacilli ; Yet it is the first condition to be satisfied, if one is to follow the hereditary factors and the spontaneous variability of the organism.

In 1899, I demonstrated at the Scientific and Medical Congress at Haarlem a method which I had discovered in 1897, for isolating a single cell under the microscope. This technique which was further developed and applied, formed the subject of my dissertation. Since then I have continued my researches on the micromanipulator ; during the last fifty years this work has developed in a direction which renders possible the adaption in principle of the same type of investigations with microorganisms as those practised in the domain of the more highly organised organisms.

The method of isolating is, in brief, as follows :—On a coverslip, which has been smeared with a little Tangkallak fat and then passed through a flame, a drop of the material is placed from which it is desired to isolate a cell. At a distance of about 3 mm. apart drops are placed in which it is desired to grow the pure culture. The coverslip is then placed on a moist chamber on the microscope stage. The lateral walls of this chamber are provided with a horizontal slit, closed by a viscid fluid and through which the isolation needles project into the chamber. By means of a simple mechanism the needles can turn round a support, so that their ends can touch the corner surface of the coverslip. Any mechanical shake renders it possible to do this in any part of the field. The space in the moist chamber is kept saturated with water vapour by a drop of water on the floor. The vapour condenses on the lower surface of the coverslip, and since the latter has been treated with fat, the condensation takes place in small rounded droplets, which do not coalesce. Before use the needles are sterilised by dipping their ends in sulphuric acid and in ammonia. As micro-organism to be isolated is now sought at the edge of the so-called material drop. The needle is moved up so that the end touches the edge of the drop near the cell that is to be isolated. Then, when the needle is moved sideways, the cell with a tiny droplet will be drawn out of the large drop. This cell is now taken up in the eyelet of the needle. This eyelet is then brought down somewhat, so that it no longer touches the coverslip, and then the moist chamber is moved sideways, under a low power, so that the eyelet, by an upward movement, comes near to the edge of one of the sterile drops and deposits the isolated cell, in a small drop (about 6 μ) on the coverslip. Under high power this small drop with the cell is moved into the sterile drop, in which the culture is made. This is repeated with other cells, and when all the sterile drops contain each a cell, the coverslip is placed on a moist chamber and incubated at the required temperature. If the culture drop is solid, the colony grows on its edge, and with the aid of a high power microscope, its development can be followed from the beginning. If the culture drop is fluid, the colony generally spreads itself over the whole drop.

So much for an outline of the method of isolating by means of eye-shaped needles. When pointed needles are used, the method is somewhat modified ; then the material (*e.g.* bac., *tuberculosis, granula*) is smeared on the coverslip, and the cells are simply picked up. In micro-operating fine glass point needles, for bacilli, a point of about 0·2 μ is used; glass knives also can be employed.

Sometimes it is considered that these manipulations require a special aptitude and practice. But with good prepared coverglasses and clean and properly made needles, the work is agreeable and not too difficult. Isolation of a bacillus and transferring in a sterile drop requires two minutes, and cutting into two of a bacillus, taking up unfolding the double-folded, takes 15 seconds.

As to the making of the needles, I know from experience that a worker, endowed with common skill, will be able to make a good eye needle after two days, on condition that he can practise under expert personal guidance.

Note.—The cost of printing this contribution has been met from a generous grant from the Indian Council of Agricultural Research, New Delhi.

BEE RESEARCH STATIONS FOR INDIA

A. S. SRIVASTAVA AND M. SREENIVASAYA

IT is customary to describe the fabulous prosperity of a country as the land flowing with milk and honey, which are universally recognised as the two essential dietetic ingredients of every well-fed people. The extent of their production and consumption may be taken as a measure of a nation's well-being. History records that India was once such a happy country : today the conditions as regards the supply of milk and honey are desperate and it is only the few rich and wealthy that can afford these luxuries. To the average American, the Scandinavian and the pre-war European, honey is an easily available article of diet. During World War II, Americans were encouraged to produce and consume more and more of honey in place of sugar which was strictly rationed ; the wax which was a bye-product of the expanding industry found extensive employment for securing the waterproofness and corrosion resistance of certain parts of ships, aeroplanes and other implements of war. Statistical data have shown that longevity of men is largely determined by the amount of honey consumed by them. It is a matter of common experience that the queen can be reared from a worker's larva by feeding it with diluted honey (royal Jelly).

Bees play yet another useful rôle as pollinators. Apiaries in many parts of U.S.A. are, in fact, carried from orchard to orchard during the blossoming period with the active co-operation of the growers, who are often willing to defray the expenses of transportation. Recent work in Russia indicates that honey produced from bees fed on various drugs have been found to possess specific therapeutic properties.

What are then the basic requirements for building up a prosperous bee industry ? How is it possible to produce more honey per hive ? These are some of the natural queries that arise in our minds. Honey yields are principally influenced by the population of a colony. For instance, hives containing population at its highest yield not only more honey per hive but also per bee than hives with small population. In other words, colony population is a very important factor. The colony population on the other hand depends on the number of brood reared or eggs laid. The number of broods are governed by the quality of the queen. A good queen lays about 1,500 eggs per day. The number of eggs laid by a queen increases with increase of colony population, comb space and abundance of supply of pollen and honey. It has been found by practice that more honey can be produced only in large colony as majority of the bees are free for field work ; whereas in a small colony most of the bees are engaged in rearing of the broods. In addition to all these factors, there should be also an abundance of natural resources in the form of nectar-bearing plants.

In India the methods for honey production at the moment are disorganised, unscientific, crude and uncertain and there is practically no large-scale industry for the production of honey. Most of the honey in the Indian market is derived from the wild beehives by certain professional tribes whose traditional and intimate knowledge of the bee and its habitat may be worth acquiring. These sources are naturally fortuitous and undependable. Methods of extraction and preservation are crude and unscientific while the trade is in the hands of unscrupulous profiteers. Due to its high price, adulteration with sugar syrup and molasses is frequent.

There are, however, great possibilities of organizing the production of honey on scientific lines with a view to not only secure steady supplies, but also to increase the production of honey. Our blossoming forests and agricultural and horticultural fields offer a rich environment for the culture of honey bees. The seasonal conditions in India are more propitious than what they obtain in other parts of the world.

Apiaries require a good location. As a rule they should be situated in well-drained areas of countryside within a range of nectar-bearing vegetation. During most of the day under all weather conditions they should receive ample sunlight and at the same time they should be screened against winds by groves or trees, which may also help the bees to fly higher and thus reduce the danger or nuisance to the farmers working on the neighbouring

fields. A natural or artificial supply of water is very necessary to be located near the apiaries for the bees. Thus an apiary, set on the bank of a river in the vicinity of blossoming orchards or agricultural crops partially surrounded by trees facing the sun during morning time, can be regarded to occupy an ideal location.

Bearing these fundamentals of practical bee-keeping in mind one can easily move ahead in establishing bee research stations in order to further the research work and disseminate this knowledge among the masses. The most spectacular advances in the science and technology of honey production have been made recently in U.S.A. A deep and earnest study of the methods of research by which American scientists improved their industry and stepped up its production, will be of inestimable value in organising our methods of honey production in India. Some of the fundamental discoveries which led to the production of higher yields of honey and to the maintenance of the health and vigour of the bees are listed :

1. Species of blossoms in relation to the quality, flavour and nutritive value of honey ;
2. Ecological and other environmental factors in relation to honey production ;
3. Study of the nutritional requirements of the queen bee and the workers.
4. Two queen or multiple queen colony system ;
5. Artificial insemination apparatus ;
6. Disease control.

So far no systematic work has been carried out on Indian bees. The production of honey could be substantially stepped up by organizing research and the following represents a scheme through which a prosperous industry may be built upon a sound scientific foundation.

1. Study of the races of the bees of India—

(*a*) Taxonomic ; (*b*) Physiological.

2. Improvements in the yield of honey from a few of the promising races.
3. Domestication of wild and promising races.
4. Breeding new races.
5. Artificial insemination.
6. Multiple queen system of bee keeping.
7. Studies in the nutrition of the queen and the workers.
8. Determination of the honey producing potential of certain ecological make-ups in agricultural and forest areas.

In our subcontinent which has such a great variety of floristic compositions and climates there should be at least five bee research stations. One of them should be centrally located and should be designated as the Central Bee Station and four others in four different places under the name Northern, Southern, Eastern and Western bee regional stations. The Central Bee Station ought to be equipped with all the modern equipment, a good library and with adequate staff consisting of a Director, a Biochemist, an Insect Physiologist, a Botanist (Systematist), a Plant Pathologist, an Entomologist, two research Assistant Entomologists, two Insectiary Assistants, two laboratory technicians, four fieldmen, one stenotypist and one librarian. Each of the four regional stations should include a staff of a Apiculturist, a Biochemist, a Botanist, an Entomologist, two research Assistant Entomologists, an Insectiary Assistant, two laboratory technicians, two fieldmen, a stenotypist and a librarian.

Every year, each of the four bee regional stations should hold a demonstration to popularise the means and methods of this industry among the masses. Adequate information and help ought to be given to those, who feel interested and may like to raise apiaries in their gardens, fields, or orchards.

Note.—The cost of printing this article has been met from a generous grant from the Indian Council of Agricultural Research, New Delhi.

NEW ANNUAL REVIEWS

THE organization of four new Annual Reviews to be published under the auspices of Annual Reviews, Inc., is announced. The first volume of each is to appear in 1950. The preliminary organization is now complete and meetings of the Editorial Committees are to be held in the immediate future.

(*a*) *Annual Review of Medicine*—Editor: W. C. Cutting, Stanford University. Associate Editor: H. W. Newman, Stanford University. Editorial Committee: A. Blalock, The Johns Hopkins Hospital; J. S. L. Browne, Royal Victoria Hospital, Montreal; A. M. Butler, Harvard Medical School; E. MacKay, The Scripps Metabolic Clinic, San Diego; S. C. Madden, Emory University.

(*b*) *Annual Review of Physical Chemistry* — Editor: G. K. Rollefson. University of California. Associate Editor: R. E. Powell, University of California. Editorial Commitee: H. Eyring, University of Utah; G. Glockler, State University of Iowa; W. F. Libby, University of Chicago; J. W. Williams, University of Wisconsin; E. B. Wilson, Jr., Harvard University.

(*c*) *Annual Review of Plant Physiology*—Editor: D. I. Arnon, University of California. Editorial Committee: D. R. Goddard, University of Pennsylvania; P. J. Kramer, Duke University; A. E. Murneek, University of Missouri; M. W. Parker, Bureau of Plant Industry, USDA; K. V. Thimann, Harvard University.

(*d*) *Annual Review of Psychology*—Editor: C. P. Stone, Stanford University. Associate Editor: D. W. Taylor. Editorial Committee: J. E. Anderson, Institute of Child Welfare, University of Minnesota; J. G. Darley, University of Minnesota; C. H. Graham, Columbia University; C. I. Hovland, Yale University; J. G. Miller, University of Chicago.

The Editorial Committees of each of the Reviews meet annually to select the topics and authors of succeeding volumes.

It is intended that in the new Reviews the editorial policies which govern the *Annual Review of Biochemistry*, the *Annual Review of Physiology*, and the *Annual Review of Microbiology* will obtain. The subject-matter of each annual volume will consist of critical appraisals of the research proceeding in the major divisions of the field. Subjects of greatest activity will be reviewed annually, while those of lesser activity, together with any topics which encompass small divisions of the field, will be reviewed biennially. The international character of the existing Reviews will be extended into the new Reviews. It is anticipated that the fifteen or twenty authors selected for each volume will be drawn from various parts of the world in which outstanding research in the subject in question is proceeding.

Annual Reviews, Inc., is a nonprofit corporation which was first constituted in 1932 to publish the *Annual Review of Biochemistry*. Since then it has initiated the *Annual Review of Physiology* (jointly with the American Physiological Society) and the *Annual Review of Microbiology*. The members and Directors of Annual Reviews, Inc., consist of H. J. Almquist, F. E. Booth Company, Inc., Emeryville, California; H. A. Barker, University of California; H. J. Deuel, Jr., University of Southerm California; J. F. Fulton, Yale University; D. R. Hoagland, University of California; J. Murray Luck, Stanford University and H. A. Spoehr, Carnegie Institution of Washington, Stanford, California.

SIR C. V. RAMAN

SIR C. V. RAMAN, the celebrated physicist, who has returned to India after visiting Europe and the U. S. A. was invited to attend an "International colloquium" at Bordeaux organised by the "Central National de la Recherche Scientifique" to celebrate the 20th anniversary of the discovery of the Raman Effect. His personal contribution at the colloquium was two reports, one on the scattering of light and the other on the dynamic reflections of X-rays. He also attended another international conference at the University of Paris convened to discuss the electronic theory of molecule formation and of the solid state.

Sir C. V. Raman also visited Belgium, the U.K. and the U.S.A. He was warmly received and was a guest of honour at meetings of learned Societies where he

addressed scientific gatherings, visited important centres of research, renewed his personal contacts, and discussed subjects of common interest with such eminent scientists as Prof. Devaux, Sir Charles Darwin and Prof. Charles Mennebeck.

At Washington he visited the departments of the National Bureau of Standards and met several heads of the Bureau. He actively participated at the General Assembly of the International Union of Crystallography at Harvard University and gave a lecture on the theory of the vibration spectra of crystals.

In New York he met Dr. Winston E. Kock and witnessed several experiments such as "focussing of short electric waves by metallic lenses," demonstration of the "visible speech apparatus" developed by the Bell Telephone Company and also the New Invention of the transistor intended to replace the thermionic valves in wireless. He also studied the collections of crystalline minerals in the American Museum of Natural History and saw the remarkable effects exhibited by the luminescent minerals at Franklin and New Jersey. The itinerary included a visit to the Brooklyn Polytechnic Institute where he met Prof. Hermann Mark and Prof. Fanktchen.

During his stay in the U.S.A., Sir C. V. Raman contributed a monograph on "Diamond" for publication in the Encyclopedia of Commercial Technology published by Inter-Science Publishers.

MODERN TRENDS IN SYSTEMATICS*

SYSTEMATICS is that ground-discipline of Biology which concerns itself firstly, with the orderly arrangement of the living world into a convenient and, as far as possible, natural system of hierarchical categories such as orders, families, genera, and so forth ; secondly, with the distinguishing of one form or species from another, in the gamut of millions of species, both living and extinct ; and thirdly, with the elucidation of the mechanisms by which these distinctions arise in nature. Systematics is sometimes also called 'Taxonomy', a term which merely means the disposition of things in a rational and lawful manner.

It was recognized early in the history of science that the lowest easily recognizable systematic unit is the species. And the problem that framed itself in the minds of scientists was how to name these millions of living species so as to avoid confusion when mentioning one or the other. This knotty problem was solved in the middle of the 18th century through the genius of the Swedish botanist, Carl Linnaeus, who invented the 'binominal' system of nomenclature. According to it, each species is written with two names—the first the generic, and the second the specific—in much the same way as our own surnames and 'christian' names respectively, with this important difference that our names refer to individuals and not to the species. Thus, the tiger is named *Felis tigris*, the leopard *Felis pardus*, and the jungle cat *Felis chaus*—*Felis* being the generic name for all these members of the cat-family Felidae. Man's name is *Homo sapiens*. By international agreement, the following procedures find universal acceptance : (i) Within the same genus, one specific name can be employed for one species only, the name proposed earliest being the one accepted (rule of priority), so that one specific name can refer to one species and one only. (ii) The 10th edition of Linnaeus's *Systema Naturae*, published in 1758, is taken as the starting point for names of animals. (iii) The specific and generic names are latinised, and are written in the Roman script.

Later, when it was found that 'species' are not fixed but evolving, and that it is possible to recognize systematic units lower than the species, systematics was gradually transformed from a static into a dynamic discipline. The present Address deals principally with the modern dynamic trends of development during the last 30 years. The chief achievements of this period consist briefly of the following : Firstly, a large number of intraspecific systematic categories have been recognized, such as subspecies, races, forms, varieties, pure lines, and so forth. Secondly, it is now clear that species are generally made up of a number of these lower groups or

* Abstract of the Presidential Address delivered by Major Dr. M. L. Roonwal, to the Section of Zoology & Entomology, Indian Science Congress, Allahabad, January 1949.

complexes (form-groups, race-groups, etc.). Thirdly, modern systematics now plays a most significant role in the study of the mechanisms of 'speciation', by which term we mean those phenomena which are concerned in the origin of new species and subspecies. Among the most important of these mechanisms is the recently found statistical effect of population size on the intensity of speciation. Thus, it has been shown that new species will arise most rapidly in a population which is of intermediate size and is divided into a number of smaller, partially isolated population-groups. Lastly, the great practical importance of systematics is discussed, and some suggestions are made for the future development of that discipline.

MATHEMATICAL PROCEDURE IN STATISTICAL THEORY*

THE Presidential Address is an exposition of the basic elementary mathematical principles underlying the theory and application of statistical methods.

Experiments in any field of human activity yield values of a number of variables—$x_1, x_2, \ldots x_k$. In a k-dimensional Euclidean space the results of observation can be denoted by a finite number of points. The totality of all possible observations will give an infinite set of points. This infinite set is unknown and statistical theory aims at the study of this set—the unknown population through the observed finite subset which is ordinarily called the sample.

A mathematical approach to this study is to assume the existence of a distribution function. The parameters of this function will epitomise all relevant characteristics of the population estimates of these parameters can be calculated as functions of the observed set and the behaviour of these estimates in the long run of experimental evidence can be studied with the help of their sampling distributions.

In this connection, two remarkable results—the Law of Large Numbers and the Central Limit Theorem—which are the outcome of extremely delicate mathematical reasoning, have given elegance and wide applicability to statistical technique. The Central Limit Theorem gives the Gaussian Normal Error Law as the dominant term in the distribution of any statistic when the number of observations is large.

The approach to normality of a large class of distribution functions has made the theory of quadratic forms and matrix algebra very important in statistical analysis. Further, the theory of approximation in the sense of Least Squares and the corresponding geometrical symbolism are also indispensable to the statistician.

*Abstract of the Presidential Address delivered by Prof. U. S. Nair, to the Statistical Section of the Indian Science Congress, Allahabad, January 1949.

IMPROVEMENT OF AGRICULTURAL STATISTICS

NECESSITY for improvement in the methods of collection of data on agriculture, particularly on yield of principal crops, existed from a long time in India. Lack of accurate figures has made it difficult to judge the degree of success of several development schemes, particularly schemes connected with 'Grow More Food'.

The fact that Random Sampling method is reliable for collection of accurate data was known from a long time and its practicability has now been recognised by the Advisory Board of the Indian Council of Agricultural Research.

At the suggestion of the Advisory Board, all Provinces of India will take up this method. The main objects will be to estimate the yield per acre for the Provinces as a whole and to fix the district normal yields for important crops.

LETTERS TO THE EDITOR

PAGE

On the Completely Unbiassed Character of Tests of Independence in Multivariate Normal Systems—R. D. NARAIN .. 41

New Band Systems of the Tl Cl Molecule—P. TIRUVENGANNA RAO 42

The Emission Spectrum of Bismuth Iodide P. TIRUVNGANNA RAO 42

Pleochroic Halo from the Chota Nagpur Granite—M. S. DORAISWAMI 42

Bereks' Compensator—P. R. J. NAIDU .. 43

Electrolytic Preparation of Azo Dyes II—V. V. RAMAN, AND M. V. SITARMAN .. 44

A Preliminary Note on Diseases of Gram—S. C. DAS AND D. P. MOTIRAMANI .. 46

Alkali-Sensitive Linkages in Irradiated Cellulose—T. S. A. PADMANABHAN, L. R. SUD, P. F. E. MANN, S. K. RANGANATHAN AND T. S. SUBRAMANIAN 47

PAGE

The Preparation of Transparent Jellies of Aluminium Molybdate—S. P. MUSHRAN 48

Chemical Investigation of the Seeds of Jatropha curcas *Linn.*—C. M. DESAI AND M. T. VYAS 49

The Dinitration of Meta-Chloracetanilide—B. B. DEY, R. KRISHNA MALLAH AND B. R. PAI 49

Preliminary Antimalarial Screening Tests of some Biguanide Derivatives—A. L. BAMI, S. NATARAJAN, A. S. RAMASWAMY, N. N. DE, B. H. IYER AND P. C. JAIN .. 50

Influence of Hydroxycarboxylic Acids on the Reaction Between α-Naphthylamine and Dichromate and α-Naphthylamine and Vanadate—M. NARASIMHA SASTRI AND J. V. S. RAMANJANEYULU 52

A Preliminary Investigation into the Viability of Immature Embryos of Corn under Conditions of Cold Storage at Freezing Point—P. UTTAMAN 52

ON THE COMPLETELY UNBIASSED CHARACTER OF TESTS OF INDEPENDENCE IN MULTIVARIATE NORMAL SYSTEMS

To prove the unbiassed character of likelihood ratio tests like the test of significance of the multiple correlation coefficient or Hotelling's T^2 test, Daly (1940) used the non-null frequency distributions of these test criteria. This leads to obvious difficulties when tackling the general regression problem and the test of independence of several sets of variates, and Daly (1940) has shown only their locally unbiassed character.

This paper demonstrates an approach which does not require an explicit knowledge of the frequency distribution of the test criteria, and it has been possible to prove that the likelihood ratio test for the general regression problem and the Wilk's criterion for independence of sets of variates, are completely unbiassed.

As the simplest demonstration of the procedure which is applicable generally, consider the t-test for the significance of the mean of a normal population. Let the frequency function of a sample of size n be

$$(2\pi V)^{-\frac{n}{2}} e^{-\frac{1}{2V}\sum_{i=1}^{n}(x_i-m)^2} \prod_i dx_i.$$

The region $W-w$ complementary to the critical region w for testing the hypothesis, $m=0$ is given by

$$\bar{x}^2 \leqslant K^2 \chi^2,$$

where K^2 is a positive constant depending on the size of the critical region and

$$n\bar{x} = \sum_i x_i$$

$$\chi^2 = \sum_i (x_i - \bar{x})^2.$$

We write

$$I(m) \equiv \int_0^{\infty} \left[\int_{-K\chi}^{K\chi} e^{-\frac{n}{2V}(\bar{x}-m)^2} d\bar{x} \right] f(\chi^2)\, d(\chi)$$

where

$$f(\chi^2)\, d(\chi^2)$$

is the frequency function of χ^2 which is distributed independently of $\bar{x}$. To show that the test is completely unbiassed is equivalent to showing that

$$I(m) \leqslant I(0)$$

We have

$$\frac{\partial I}{\partial m} = \int_0^\infty \left\{ e^{-\frac{n}{2V}(k\chi+m)^2} - e^{-\frac{n}{2V}(k\chi-m)^2} \right\} f(\chi^2)\, d(\chi^2)$$

which is positive or negative according as m is negative or positive. Therefore

$$I(m) \leqslant I(0).$$

The completely unbiassed character of the E^2-test (Tang, 1938), by stating the problem in its canonical form and following the above method of argument, can easily be shown to follow from the complete unbiassedness of the t-test just proved. This chain of reasoning can be followed up to show the completely unbiassed character of the likelihood ratio test for the general regression problem and then further of the Wilk's criterion.

Detailed proofs will be published elsewhere.

Indian Council of Agric. Research, New Delhi, *December* 28, 1948. R. D. NARAIN.

Daly, J. F., "On the unbiassed character of likelihood ratio tests for independence in normal systems," *Anns. Math. Stats.*, 1940, **11**, 1. Tang, P. C., "The power function of analysis of variance tests with tables and illustrations of their use," 1938, **2**, 126.

NEW BAND SYSTEMS OF THE *TlCl* MOLECULE

EXCITING the vapour of thallium chloride in a high frequency discharge through a continuously evacuated pyrex tube, two new systems of bands, one between λ 4300—λ 4150 and the other between λ 4150—λ 3300 have been obtained in addition to the band system around λ 3200 analysed by Howell and Coulson.* The more refrangible system consists of about 75 bands in all which are degraded in either direction, while a few of them are headless and diffuse. The other system consists of about 18 bands which are mostly degraded towards the red, though a few of them are violet-degraded. The vibrational analyses of these two systems have shown that the lower state, which is found to be common to both of them, is the upper state of the ultraviolet system $^3\Pi - {}^1\Sigma$, established by Howell and Coulson. Predissociation similar to that found in the upper state of the ultraviolet system, is observed in the lower state of both the systems at $v'' = 5$. The following vibrational constants have been determined for the more refrangible system.

$$\nu_e = 24683{\cdot}3 \qquad \omega_e' = 101{\cdot}3 \qquad \omega_e'' = 206{\cdot}5$$
$$\chi_e'\omega_e' = 0{\cdot}1 \qquad \chi_e''\omega_e'' = 6{\cdot}5$$

The locus of intense bands in this system falls on a Condon parabola which is to be expected with such relative values of ω as occur here. The following constants are suggested for the other system.

$$\nu_{0,0} \sim 24040 \qquad \omega_e' \sim 100 \qquad \omega_e'' \sim 205$$

The chlorine isotope effect observed in the system supports the vibrational analysis.

The close proximity of these two systems suggests that the upper levels may form an electronic doublet.

Details will be published elsewhere.

Andhra University, Waltair, *January* 2, 1949. P. TIRUVENGANNA RAO.

* Howell and Coulson, *Proc. Roy. Soc.*, 1938 **166**, 238.

THE EMISSION SPECTRUM OF BISMUTH IODIDE

A NEW BAND system between λ 5900—λ 5650, attributed to the diatomic molecule, BiI, is recorded in emission in a high frequency discharge, in addition to the band system with origin at $\nu = 23388{\cdot}9$ cm.$^{-1}$, reported by Morgan.* Vibrational analysis of this system has led to the determination of the following vibrational constants.

$$\nu_e = 17216{\cdot}0 \qquad \omega_e' = 195{\cdot}0 \qquad \omega_e'' = 167{\cdot}9$$
$$x_e'\omega_e' = 1{\cdot}0 \qquad x_e''\omega_e'' \sim 0{\cdot}3$$

By analogy, this system may correspond to the low frequency system observed in the other bismuth halides.

Details will be published shortly.

Andhra University, Waltair, *January* 19, 1949. P. TIRUVENGANNA RAO.

* Morgan, *Phy. Rev.*, 1936, **49**, 47.

PLEOCHROIC HALO FROM THE CHOTA NAGPUR GRANITE

WHILE consulting literature regarding the occurrences of pleochroic haloes in minerals, the description of a pleochroic halo mentioned by Dr. L. A. N. Iyer[1] in granite from Chota Nagpur was noticed. He records, "In one of the crystals of biotite in the granite from south of Jatiba, a good pleochroic halo is present with a dark red grain in the centre, which is presumably zircon. It shows an inner lighter

ring and an outer darker ring." He then cites the measurements by Joly[2] and says, "The radius of these haloes vary only between 0·0152 mm. and 0·0160 mm., in Europe in rocks of pre-Cambrian age; whereas the halo above referred to in the Chota Nagpur granite has a radius of 0·030 mm., nearly double that of those recorded in European rocks." He has explained that it would be a thorium halo.

Referring to Joly's paper[3] we find that the dimensions of haloes which he has attempted to compare with progressive geological aging is that of the primary uranium haloes. These correspond to alpha-particles which exhibit maximum of ionisation in air at a distance of 2·2 cm. This primary uranium halo represents the earliest stage in the development of pleochroic haloes.[4] In fully developed normal haloes where we find a series of concentric rings, the outermost radius in the case of the uranium haloes corresponds to the alpha-particles from RaC. The measurements on this as given by Joly in his paper gives an average of 0·032 mm. The rings formed as a result of the disintegration series of the thorium family give measurements in biotite as 0·041 mm.; 0·023 mm.; 0·011 mm., etc.

From the description and the microphotograph of the halo in the Chota Nagpur rock, it appears that it is a normal halo of the uranium series and that the outermost ring as is to be expected corresponds to the range of alpha-particles from RaC and hence measures about 0·030 mm. as recorded by Dr. Iyer. The simple explanation that it represents RaC of the uranium series fully satisfies the measurements.

Geology Department, M. S. Doraiswami.
Andhra University,
Waltair,
January 11, 1949.

1. *Rec. G.S.I.*, 1931, **65**, 500. 2. *Proc. Roy. Soc., Ser. A*, **102**, 682, *et seq.* 3. *Ibid.*, p. 694. 4. *Phil. Trans. Roy. Soc., A*, **217**, 51 *et seq.*

BEREKS' COMPENSATOR

There is an impression that, if the tables supplied by the makers of the Bereks' compensator is lost, the compensator cannot be used. Rogers and Kerr[1] remark, "the value is inserted in a simple formula supplied by the makers of the instrument. Solution of the formula gives the correct retardation for the mineral grain." This might be interpreted to mean that the formula is that of the makers, and that therefore the tables supplied by them are necessary for its use. This is not so. The formula given by the makers is—

$$\text{Log } \Gamma = C + \log f(i).$$

This is a method of solving by logarithms the well-known formula for retardation; $\Gamma = C \times f(i)$ or $R = K \times D$ (given by Johannsen for the use of the Babinet compensator)[2] where Γ or R = retardation of the mineral to be determined, C or K = the constant of the Bereks' compensator determined on any microscope, and $f(i)$ or D, the reading of the drum of the compensator for any mineral, whose birefringence is to be determined.

If the tables are lost, the procedure is :—

The Bereks' compensator is calibrated for white light by reading the divisions on the drum from the first order violet on the one side of the black cross to the first order violet on the other side. Say the readings are 44·2 and 15·1. Then 44·2 minus 15·1 divided by two = 14·55 = λ = 550 μμ (the wavelength of white light). Therefore the constant C or $K = \frac{550\mu\mu}{14{\cdot}55}$.

The mineral (say hypersthene) is then placed on the stage and turned 45° from the position of extinction with its C-crystallographic axis ⊥, to the long direction of the compensator, and the drum read from the dark bar of compensation on the one side to the dark bar on the other. Say the readings are 54·7 and 4·8. Therefore $f(i)$ or D = 54·7 minus 4·8 divided by two = 24·95. Applying the general formula for retardation, Retardation of hypersthene Γ or R = C or $K \times f(i)$ or $D = \left(\frac{550\,\mu\mu}{14{\cdot}55}\right) \times 24{\cdot}95$, and solving by logarithms, log Γ or R = log 550 + log 24·95 − log 14·55, using Clarkes' tables, Γ or R = 943·2 μμ. Birefringence $(n_2 - n_1) = \frac{R}{M}$, where R = retardation and M = thickness of the section.[3] The thickness of hypersthene is measured by a micrometer serew. In this case it is ·06 mm., which is expressed in μμ = 60000. Therefore birefringence of hypersthene is $\frac{943{\cdot}2\mu\mu}{60000\mu\mu} = {\cdot}0157$.

(The microscope used in this case is Leitz 313769 with objective P_3 and ocular P_1 5×).

Central College, P. R. J. Naidu.
Mysore University,
February 10, 1949.

1. Rogers, A. F. and Kerr, P. F., *Optical Mineralogy*, 1942, p. 77. 2. Johansen, A., *Manual of Petrographic Methods*, 1918, p. 375. 3. *Op. cit.*, p. 370.

ELECTROLYTIC PREPARATION OF AZO-DYES—II

A. Effect on Dye Yield of Duration of Electrolysis

THE mechanism of the formation of azo-dyes at the anode in an electrolytic cell was discussed in an earlier communication.[1] It was observed that hydroxyl ion discharge at the anode is likely to interfere with the discharge of nitrite ions, so that the chances of the amine getting diazotised with 100% current efficiency were remote. If this were true, a good deal of nitrite would be left unreacted at the end of a run during which only the theoretical quantity of current had been passed. A higher yield of the dye should therefore be obtained if the current were passed for more than the theoretical period of time. This was found to be so. The electrolysis was carried out under the same conditions as before, but the current was passed for thrice the time theoretically required, at a current density of 5 amps./dm.^{2} The yield of dye was found to be better, and there was no deterioration either in the colour of the dye or in the shade produced by it on silk. Yield of dye: 2·4 gm. or 48% of the theoretical.

It is interesting to mention at this point that Brockman and Griffin[2] report a similar observation in connection with the electrolytic preparation of another dye, Orange II. On investigation, qualitative agreement with their observation was noticed, but as with Roccelin, it was not possible to secure the same yield of dye that they claim.

A mixture of sulphanilic acid (2·5 g.), β-naphthol (1·8 g.), sodium hydroxide (0·8 g.), and sodium nitrite (1·0 g. in 150 cc. of water), were electrolysed for the theoretical length of time. The current density employed was 5 amps./dm.^{2} After the electrolysis, the dye was precipitated as the barium salt by the addition of barium chloride solution, filtered washed and dried. Yield of dye: (Ba salt) 1·55 g. or 31 % of the theoretical.

Brockman and Griffin claim to have obtained this dye in 46·8% yield, and better still, *i.e.*, 67·7 % when twice the theoretical amount of current had been passed.

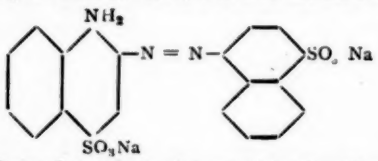
This claim could not be verified. On passing the current for three times the theoretical length of time, other conditions remaining the same, the yield of dye improved but amounted only to 2·77 gm. of the barium salt, or 55·4% of the theoretical yield.

The dye had a good red colour, and the colour on silk was quite pleasing and compared very favourably with the shade produced by Orange II prepared in the usual way.

B. Preparation of Congo Red

The study of disazo-dyes has a twofold interest. In the first place, this group of dyes, headed by Congo Red, forms the commercially well-known group of dyestuffs known as the direct cotton dyes, on account of their ability to produce good, fast shades on cotton fabric without the aid of mordants. Secondly, it is generally not so easy to prepare these dyes as it is to prepare mono-azo dyes. For one thing, tetrazotisation (*i.e.* diazotisation of both the amino groups) of the benzidine base is difficult, and then, the velocity of the coupling slows down to a very great extent when one of the two diazotised groups has coupled.

Brockman and Griffin (*loc. cit.*) who have studied the formation of Congo Red in the electrolytic cell, report an additional complication. After electrolysing the proper components in the manner already described at a platinum anode, they state that instead of the anticipated Congo Red, a dye of the structure:



was formed through the partial diazotisation of the sodium naphthionate and coupling with unreacted naphthionate; Congo Red being obtained only in minute amounts. They therefore contradict the claim made by Löb[3], that Congo Red could be got by electrolytic methods.

This problem was considered worth study, since the practical value of a good method of getting direct cotton dyes by electrolytic methods already outlined cannot be underestimated.

Since the most important aspect of the problem is the tetrazotisation of benzidine, a coupling component that is unlikely to interfere with this step in the formation of the dye had to be used. The closest analogue to sodium naphthionate is the sodium salt of Nevile-Winther's acid (1, 4-naphthol sulphonic acid). There is no risk of interference from the coupling component to the tetrazotisation of benzidine, if this acid were used, since there are no amino groups in it.

EXPERIMENTAL

The cell employed for the electrolysis has been already described.[1] Nevile-Winther's acid

Current Science, Vol. XVII, 1948

Author Index

	Page
A. A.	369
A. A. K.	233
Adcock, F.	161
Airan, J. W.	22, 150, 262
Aiyengar, N. K. N.	211
A. K. Y.	281
Ananthakrishnan, R.	163
Appaji Rao, B.	124
Arlick, Alfred B.	20
Appanna, M.	154
Asana, R. D.	360
Aswathanarayana Rao, S. R.	29
Ayodhya Prasad	180
Azad, R. N.	216
Balakrishna Rao, S.	210
Bami, H. L.	90, 186, 272,
Banerji, B. K.	214, 332
Banerji, K. S.	356
Baptist, N. G.	236
Barooah, S. K.	273
Basu, U. P.	159
B. C. G.	160
B. D.	309
Bhagavantam, S.	193, 233, 296
Bharat Bhushan	359
Bharucha, F. D.	262, 358
Bhat, J. V.	157, 183, 213, 264
Bhat, M. V.	184, 264, 298
Bhatnagar, D. P.	25
Bhatnagar, Sir S. S.	137
Bhide, B. V.	125
Bhimasena Rao, M.	334
Binayendra Nath Sen	182
Biradar, N. S.	324
B. N. N.	279
Bose, S. R.	305
Bragg, Sir Lawrence	230
B. S. I.	195
Butani, D. K.	127
B. V. N.	282
Capoor, S. P.	57, 151, 152, 264, 274
Carter, B. C.	100, 129
Cawston, F. G.	262
Chacko, P. I.	93, 157, 158, 191
Chada, S. R.	310
Chakrapani Naidu, M. G.	181, 330
Chakravarthi, S. C.	299
Chakravarthi, S. P.	131
Chandrashekara Aiya, S. V.	222, 308
Chandiramani, S. V.	60
Channabasappa, K. C.	181
Chatterjee, D.	92
Chittaranjan Mitra	51
Chitre, R. G.	34
C. N. S.	193, 222
C. R. H.	330
C. R. N.	160
Daji, J. A.	259
Das, A. K.	307
Dasannacharya, B.	308
Das Gupta, S. R.	268
Davis, T. A.	270
De, N. N.	12, 237, 279, 280
De, S. S.	51
Deoras, P. J.	301
Desai, T. B.	333
Desikachar, H. S. R.	52, 297, 331
Dey, B. B.	249
Dharmatti, S. S.	324
Diptish Chakraborty	328
Dutt, N. L.	241, 270
Fernandes, F.	157
Fernando, I.	362
Ganapathi, K.	77, 262, 358
Ganesan, A. S.	87
Garg, D. N.	269
George, C. A.	122
George, Mariam	357
Ghadiali, H. P.	332
Gopalakrishna, H. V.	109
Gopalakrishna Murthy, N.	149
Guha, P. C.	53, 89, 90, 126, 184, 185, 238, 264, 272, 298, 330
Gupta, P. R.	53, 185, 238
Gurbaxani, M. I.	93, 122, 245
Handa, K. L.	54
Hansraj Gupta	180
Hari Narain	50
H. R.	368
H. S. R.	339
Inderjit Singh	101, 306, 321
Iyer, B. H.	53, 89, 90, 126, 184, 274, 298, 330
Jatkar, S. K. K.	309
Jayadev, C. H.	194

	Page
Jayadev, C. J.	36
Jayaraman, V. S.	248
Joshi, K. D.	146
Joshi, M. L.	359
Joshi, N. G.	54
Kane, J. G.	150, 277
Kapoor, L. D.	54
Kar, Amiya B.	91
Karam Singh	220
Karunakaran, C.	260
Khorshed Sethna	157
Khoshoo, T. N.	242
Kostoff, Dontcho	294, 315
Krishnan, B. R.	168
Krishnan, R. S.	37
Krishnamurthi, B.	158
Krishnamurthi, C. R.	23, 51
Krishnamurthi, S. N.	92
Krishna Maller, R.	239
Krishnaswamy, S.	190
Krishnaswamy, V.	271
Krishnaswamy Ayyangar, A. A.	261, 356
Kulkarni, Y. S.	189, 243
Kuriyan, G. K.	191
Lahiri, K. C.	296
Lakshminarasu, S.	131, 366
Lakshmikantam, M.	90
Lakshminarayana, H.	159
Lalani, A. M.	155
L. S. R.	86, 163, 339
L. S. S. K.	194
Lulla, B. S.	23, 24
Madhava Rao, B. S.	343
Madhu Raghunath	212, 264
Mahabale, T. S.	187
Mahadevan, C.	25, 149, 297, 340
Mahdihassan, S.	184, 301
Malurkar, S. L.	47, 112, 205, 210, 348
Mani, V. S.	360
Mata Prasad	324
Mazumdar, A. K.	88
M. B. R.	61
M. C. S.	355
Menon, K. P.	371
Menon, P. M. G.	156
Misra, K. C.	91
Mitra, Chittaranjan	51
Mitra, K. K.	55
M. J. N.	311
Mohanty, S. R.	148, 215
Moniz, L.	189, 268
Moorjani, M. N.	123
M. R. A.	132, 215
M. R. N.	147
M. S. T.	98
Mudaliar, S. V.	303
Mukerji, B. K.	55
Mundkur, Balaji D.	26
Murthy, G. V.	363
Muthanna, M. S.	97
Nabar, G. M.	278
Nagaraja Sharma, R.	165
Narasimha Sastry, M	327
Narasinga Rao, A.	25
Narasinga Rao, M.	260
Narayana, N. N.	186
Narayanan, E. S.	269
Narayana Swamy, K.	367
Narlikar, V. V.	180, 355
Narwani, C. S.	123
Natarajan, C. V.	30, 166
Nayar, M. R.	187
Nazir Ahmed	362
N. G. C.	310
N. N. D.	250
N. S. N.	355
Oak, S. C.	28
Padmanabhan, S. Y.	56
Pai, B. R.	239
Pal, K. B.	88
Pandalai, K. M.	357
Pande, C. S.	187
Panikkar, N. K.	58, 251, 374
Parthasarathy, S. V.	124
Patel, M. K.	189, 243, 245, 268
Pathak, A. N.	327
Pathanian, P. S.	244
Patwardhan, V. N.	173
Pendse, G. S.	125
Phanindranath Basu	328
Peter, C. T.	303
Pichamuthu, C. S.	223
Pillai, N. G.	285
Pillai, S. C.	93, 122, 245, 329
Pingle, S. V.	128
Pisharoty, P. R.	205
Prasad, B. N.	235
Qadiruddin Khan, M.	127
Qureshi, S. H.	366
Radhakrishnan, B. P.	212
Radhakrishnan, M. R.	262, 358
Radhakrishna Kausik	218
Raghavan, M.	330
Raghavan, T. S.	373
Raghunandana Rao, R.	23
Raghubir Prasada	215
Rai, J. N.	327
Rajagopalan, R.	245, 329
Ram Gopal	365

	PAGE
Ramachandran, E. G.	83
Ramachandra Rao, H. N.	193
Ramachandra Rao, T. N.	108
Ramakrishnan, T. S.	218, 240
Ramamurthi, K. S.	49, 81, 317
Raman, Sir C. V.	1, 65
Raman, V. S.	153
Raman, V. V.	234
Ramaseshan, S.	59
Ramaswamy, A. S.	98, 133, 237
Ramji Tiwari	355
Ram Krishna	56
Ranganathan, S.	166
Rangappa, K. S.	213
Rangaswamy, G.	240
Rao, A. R.	240
Rao, K. R.	121, 182
Rao, M. B. R.	132
Raychoudhuri, S. P.	244
Rayleigh, Lord	32
Reddy, D. V. S.	22
R. E.	96
Richharia, R. H.	275, 359
R. L. N.	279, 336
Roda N. Reporter	183
Roonwal, M. L.	133
Roy, A. C.	89, 126
Roy, S. C.	25
R. S. K.	97, 129, 335
S. A.	370
Sabnis, T. S.	101
Sadasivan, T. S.	311
Sadasivan, V.	262, 358
Saksena, B. D.	50
Sampath, S.	271
Sankaran, S.	90
Sanjiva Rao, B.	334
Sarma, S. R.	87
Sarkar, P. B.	88
Sastri, B. N.	337
Sastri, B. S.	61
Sathapathi, N.	297
Satyanarayana, M. C.	60, 84
Satyanarayana Rao, N.	27
Satyananda Rao, K.	187
Seetharama Sastry, B.	35
Sen, N. C.	363
Sen Gupta, G. C.	269
Sen, Srish Kumar	32
Seshagiri Rao, D.	223
Shah, R. C.	332, 333
Sharga, U. S.	302
Sharma, N. L.	296
Shirsat, M. V.	332
Shukla, P. D.	354
Shrikhande, J. G.	324, 364
Siddiqui, Salimuzzaman	51
Sil, J. M.	130
Singh, U. B.	266, 267
Sinha, S. P.	208
S. K. C.	99, 192, 248, 337
S. N.	29
S. N. B.	29
Sondi, H. K.	359
Soni, B. N.	52
S. P. A.	371
Spurgeon, V. D.	28
Sreenivasamurty, K.	119
Sreenivasaya, M.	141
Srinivasaiah, B. N.	16
Srinivasan, A. K.	179
Srinivasan, V.	22
Srinivasa Rao, M. R.	85
Srivatsava, A. S.	251
Srivatsava, T. N.	365
S. R. R.	222
Subba Rao, K.	334
Subramanyan, V.	51, 93, 122, 245, 297
Subbiah, R.	187, 260
Subramaniam, A. P.	211
Subramaniam, M. K.	92
Sukhatme, P. V.	11
Sundara Rao, R. V. G.	50, 296
Sundarachar, C. K.	210
Sundaram Iyer, K. V.	367
Sunita Inderjit Singh	306, 321
Talekar, V. L.	28
Tandon, S. L.	124
Tewari, J. D.	149
Tewari, L. D.	149
Thakor, V. M.	330
Thakur, R. S.	222
Thirumalachar, M. J.	26
Thuljaram Rao, J.	241, 270
Thiruvenganna Rao, P.	121, 182, 209
T. N. R.	280, 372
Trehan, K. N.	127, 128
T. S. S.	130
Uttangi, J. C.	325
Vachhani, M. V.	300
Vaidya, B. K.	320
Varma, P. M.	57, 151, 152, 265
Vasudeva, R. S.	216, 370
Venkatraman, T. V.	269
V. B.	195
Venkata Rao, C.	304
Venkateswara Rao, D.	19, 120
Venkateswarulu, A.	118
Venkateswarulu, Dr. P.	103
Verghese, James	352, 359
Viswanathan, R. V.	209
Vidyavati	305
Wadhwani, T. K.	93, 122
Waravdekar, V. S.	99
Zobairi, A. R. K.	158

Subject Index

	PAGE
Acetylene and its Derivatives, The Chemistry of (*Rev.*)	248
Acta Crystallographica (*Rev.*) ..	168
Advancement of Science, Vol. V (*Rev.*) ..	371
Aeronautical Society of India ..	284
Aerosporin for whooping cough ..	170
Agricultural Industries, VIIth International Congress of	178
Agricultural Problems of India after Partition	111
Air Masses in Tropical Cyclonic Storms from Radio-sonde data	205
Albino Rat : Influence of Dietary Factors on the Endogenous Calcium Excretion in	297
Algæ : Preliminary observations on the role of blue green Algæ in fishery ponds and in the control of Mosquito breeding	268
Alternating Current Electrical Engineering (*Rev.*)	96
Alum, Ammonium, Elastic Constants of ..	50
Amesite from Devarnarsipur, Bhadravati, Mysore	330
Aminothiazoles, Some New	298
Amylase, Influence of extracts of germinated Indian Pulses on the formation of, by *Bacillus subtilis*	23
Amylose, Preparation of, by Thymol Precipitation Method ..	366
Anæmia in Chicks Infected with *P. gallinaceum*	237
Anglo-U.S. Educational Agreement ..	311
Anils, Addition Products of, with Metallic Chlorides	330
Animals Alive (*Rev.*)	337
Annual Review of Physiology (*Rev.*) ..	279
Antibiotics, Effect of, on the Milk-clotting enzymes of *Carica papaya* and *Ficus carica*	23
Antimalarials, Studies in some N^1-(8-Quinolyl)-N^5-phenyl-biguanides ..	53
— —, Biguanide-Aryl-Arsenicals ..	162
— — some N^1-(8-chloro-5-Quinolyl)—Substituted Biguanides	185
— —: some R- and R'-Distributed Guinidines	238
— — N^1-Aryl-N^5-Alkyl-Biguanides ..	272
— —: Sulphabiguanide Derivatives ..	90
Anthropological and Ethnological Sciences, International Congress of ..	101
Arboretum, Modern	253
Areca Palm, Manganese Toxicity as a probable cause of the *Band* disease of ..	259
Argas Persicus, On the Bionomics of the Fowl Chick	366
Aromatic Carboxylic Acids, A New Method for the conversion of, into the corresponding Aldehydes	332
Arylcyanoguanidines from Aryl-azocyanoguanidines	186
Ascorbic acid and glutathione content in (human) breast cancer tissue ..	54
Association of Scientific Workers in India	284
Astronomy (*Rev.*)	307
Atomic Energy in India	134
Atmosphere, The physics of the bottom layers of	16
Atomic pile, Harwell	177
Atoms, Why smash (*Rev.*)	59
Azotus delhiensis Lal, Notes on the Life-History of the Chalcid Parasite ..	155
Bacteriology, General (*Rev.*) ..	280
Bagasse Ash, Phosphate from ..	262
Band Spectrum of Thallium iodide ..	182
Barium Nitrate, Elastic constants of Single Crystals of .. .	296
'Bekti', On the food in the cold season of	156
Berseem, Dodder or Love vine on, in U.P.	267
Beta-ray Counters	37
Biguanides, Some, Studies in Antimalarials	185
Biochemistry, The place of, in India ..	17
Biology of Pathogenic Fungi (*Rev.*) ..	369
Bionomics of *Catla catla* (C and V) in South Indian Waters	191
Blister Blight in Ceylon	134
Blood-Fluke problem in India ..	36
Bose Institute (Anniversary) ..	17
Botanic der Gegenwart und Vorzeit von Karl F. W. Jessen (*Rev.*)	310
Botanical Society of Bengal ..	170, 342
Brassicæ Oil—Seed Crops, The Effect of the Cultivation of, on soil fertility ..	300
British Aircraft Industry (*Rev.*) 1948 ..	194
— Commonwealth of Nations Scientific Liaison Offices	226
Bureau of Physico-Chemical Standards, International	146
Butter, Microflora in	159
Calcium in presence of Magnesium, Direct Volumetric Determination of ..	118
Calcutta University, Nuclear Physics in ..	169
Cane Juice and Jaggery Recovery, Influence of Graded doses of Nitrogen on the quality of	90
Capacitors, Series : Resume	109
Carboy as a Chinese Word	301

	Page
Carica papaya, A Mosaic Disease of, in the Bombay Province	265
Carp ova and its hatching, Note on	362
Catalysis of the reaction between Vanadate and Aromatic Amines catalysed by the Oxalate ion	327
Cathode-Ray Oscillograph in Industry (*Rev.*)	222
Catla catla (C and V), On the bionomics of, in South Indian waters	191
Cavendish Laboratory, Organisation and Work of	230
Central Library for India, National	169
Centropages, furcatus Dana, A preliminary note on the eye of	190
Chalcid Parasite, Notes on the Life-History of	155
Chemists, Institute of, India	159
Chemistry in India, Profession of	110
—, Elementary Analytical (*Rev.*)	30
Christian Huygens and the Development of Science in the Seventeenth Century (*Rev.*)	193
Chula ("Herl"), The smokeless	64
Citrus Vulgaris Shrad and Food poisoning	213
Coal: Freezing the Earth to mine coal	341
Coffee pulp for Cattle feed	64
Complex compounds between lead nitrate and alkali nitrates, A note on the formation of	187
Compost, Conference on	32
Congress of Commonwealth Universities	226
Constitution of phenyl thiourea	341
Corundum and Chromite-bearing Rocks of the Sithampundi, Ramadevam Area, A Note on the Petrology of	211
Cosmic Ray Conference	86
Cotton Committee, Indian Central	134
Cotton, Diseases of, in India (*Rev.*)	311
— Seed and Cotton seed Products—their Chemistry and Chemical technology (*Rev.*)	277
Crystals, Dynamic X-ray reflections in	65
Crystal Physics and Sir C. V. Raman—Supplement to the December issue	i-x
— structures, The Eigenvibrations of	1
Cyclo-Octatetraene (C_8H_8), The force constant in	50
Cymene: Production of p-Cymene from Carene	359
—: Reactions of p-Cymene	352
Cytogenetics and plant breeding (*Rev.*)	372
Cytogenetics of *Nicotiana tabacum* var. *virri* resistant to the common tobacco mosaic virus	351
Cytomixis, A case of, in *Crotalaria medicaginea* Lamk.	27
Dairy Products, Chemical and Physical Investigations on (*Rev.*)	249
— Science Association, Indian	31
Darluca filum (Biv.) Cast, a Hyperparasite of *Puccinia graminis* and *Puccinia triticina* in the green house	215
Datura alba nees, A Mosaic disease of	151
Dental Fellowship, Watumull	134
Department of Scientific Research	251
Derivatives, 2-Thiol-4 : 5-Diphenyl-imidazole	184
De Revolutionibus (*Rev.*)	163
Desmodium gangeticum De, A new bacterial leaf-spot of	268
Desizing washings, Utilisation of, for the culture of industrially important micro-organisms	24
Diamonds in Industry	258
Diatomic Molecules, Dissociation Energies and Spectra of (*Rev.*)	131
Diazomethane on triacetylgalloyl chloride, Action of	264
Dichanthium annualatum Stapf, Polyembryony in	91
Diet surveys in India, Notes on the Results of (*Rev.*)	166
Differential Geometry of Ruled Surfaces (*Rev.*)	193
Diphtheria Toxin in Submerged Culture with Aeration	328
Director-General of UNESCO	367
Divalency of Silver, On some Physico-Chemical evidence for	182
Doctorate, Award of	62
Dodder or Love Vine on Berseem in U.P.	267
Dolichos lablab Linn., Enation mosaic of, A New Virus Disease	57
Draft Indian Standard for Shrinkage Test	284
Drought Resistance of Plants in Relation to Hysteresis in Sorption	334
Drug Museum for India	169
Earthworms: Spinctered Apertures in the Intersegmental septa of	305
Ecological Society, Indian	62
Edison: The Diary and Sundry Observations of Thomas Alva Edison (*Rev.*)	337
Education, Central Institute of, Delhi	31
Education, Scientific, through Films	102
Elastic Constants of Single Crystals of Barium Nitrate	296
Electro-Chemical Research, Donations for	102

	PAGE
Electron and Nuclear Counters (*Rev.*) ..	308
Electrons (+ and −), Protons, Photons, Neutrons, Mesotrons and Cosmic Rays (*Rev.*)	130
Embryo-Sac in some Sterculiaceae, Development of	304
Embryology of the Vertebrates, Fundamentals of (*Rev.*)	250
Emission Bands of Manganese Chloride..	209
Endocrines and Constitution in Doves and Pigeons (*Rev.*)	223
Engineering and Industrial Science, Records and Research in (*Rev.*) ..	98
Entomological Society of India ..	134
Epilachna—28—Punctata, The Larval Parasite	154
Eradication of Water-Hyacinth and Production of Compost Manure (*Rev.*) ..	340
Exchange of Scientific Knowledge: Australia and India	232
FAO Office for Asia and Far East ..	342
Fatty Oils, Aniline point of ..	150
Fellowships to French Graduates ..	316
Ferromagnetic Materials, New Developments in (*Rev.*)	59
Ferrous Metallurgy, Some developments in	75
Festschrift zum boe Geburstage von Professor Dr. Embrie Strand (*Rev.*) ..	133
Films, Scientific	75
Field Guide to Birds of the West Indies (*Rev.*)	370
Finches, Darwin's (*Rev.*)	160
Flame Spectrum of CuCl, On the ..	208
Foods, Dehydration of (*Rev.*) ..	160
Foods, Refrigeration of	252
Forest College at Coimbatore, Development of	169
Forest Ranger College at Dehra Dun ..	253
Frequency Curves, Possible use of, in the Classification of Gyrogonites ..	87
Fruits and Vegetables, Preservation of ..	135
Function $\tau(N)$ (Ramanujan's), The Vanishing of	180
Gallium, Presence of, in Micas and Schists	87
Gambusia affinis (Baird and Girard), the Exotic mosquito fish, in Madras Waters, On the habits of	93
Gammexane and cattle tics	25
Gammexane (666), Trials with, against Insects affecting Grains in Stores ..	127
Gastrodiscus secundus Looss, On a new Cercaria, determined to be the larva of	303
Gavialis, Replacement of teeth in ..	262
Geological Congress, International ..	101
Geological, Mining and Metallurgical Society of India: Annual General Meeting	284
Geomagnetic storms 64, 147, 253,	375
General Relativity, The Canonical Co-ordinate System in	180
General Biology (*Rev.*)	368
German Research in World War II (*Rev.*)	161
Glacial Geology and the Pleistocene Epoch (*Rev.*)	222
Glass, Photosensitive	58
Glazed pans for raising sugarcane seedlings	270
Goniometer cum Microscope.. ..	135
Gourami nests in a hill spring and a rocky gundam	28
Graphic Arts (*Rev.*)	194
Gravitation, On Einstein's Generalised Theory of	355
Greenwich to Hurstmonceaux ..	64
Gum-Arabic, Influence of Heat on the Physico-chemical properties of ..	123
Haemorrhage (*Rev.*)	280
Heat Conductivity and Molecular Weight of Liquids	148
Heat Lows: Effect of afternoon heat lows on winds at lower levels ..	47
Hemipterous Insect pests in India, Biological Control of	302
Herbage and Fodder Plants (*Rev.*) ..	281
Hexachlorocyclohexane, Cytogenetic Changes and A typical Growth induced by	294
High Polymers, Mechanical Behaviour of (*Rev.*)	308
Hilsa ilisha (Hamilton), The Radii of Scales as an index of growth and age of	158
Hotelling's Weighing Problem ..	356
Hotter the Sun, Cooler the Earth ..	49
Hypersthene, Optically positive, from charnokites of Guntur district ..	25
India and Australia: Exchange of Scientific Knowledge	232
— Society of Agricultural Statistics ..	346
Indian Association for the Cultivation of Science (1876-1948)	251
Indian Dairy Association	196
— Journal of Dairy Science	229
Indian Medicine	171
— Meteorological Department, Scientific Notes (*Rev.*)	168
— — — Memoirs (*Rev.*)	168
— Standards Institution, Chemical Division	340

	PAGE
Indigenous Medicine, Central Institute of	226
Industrialisation and the National Government	197
Industrial Electric Furnaces (*Rev.*)	192
Industrial Research Council, India	31
Insecticides, Chemical: Vol. I of a Catalogue of Insecticides and Fungicides (*Rev.*)	251
Insect Parasitism and Superparasitism, Experimental Studies on	269
— Pests of Cotton in India (*Rev.*)	223
— Tumour and Ovarial Hormone	184
Institute of Sciences, National	135
International Bureau of Physico-Chemical Standards	146
— Commission on large Dams	252
— Conference on Standardisation	276
— Congress of Applied Mechanics	347
— — of Industrial Medicine	226
— — — Food and Agricultural Industries	170
— Congresses, Forthcoming	323
— Council of Scientific Unions	342
— Depot of Microscopic Preparations of Cytology	177
— Rules of Botanical Nomenclature (*Rev.*)	370
— Understanding, Bureau for	62
Inter-specific Cross, Sex condition in: *Luffa ægyptiaca* × *Luffa acutangula*	275
Ionospheric Transmission, Fundamental Principles of (*Rev.*)	307
Ipomea muricata, A New Bacterial Disease of	245
Isotopes, Radio active, Procurement of	232
Joshi Effect, An Explanation of the Inhibitive Influence of the Applied Potential on, and its enhancement in H. F. Component of the Discharge Current	235
Jowar Stem-borer (*Chilo zonellus* Swinlioe), Life History, Bionomics and Control of	127
Jute Committee's New Secretary	375
Kamala Seed, Oil from	312
Kaushika Prize for 1947 (Bombay)	375
Kuntslicha New Elemente (*Rev.*)	335
Lady Tata Memorial Trust Scholarship	32, 196
Lagenaria vulgaris Ser in the Bombay Province, A mosaic Disease of	274
Language medium for Science in Colleges	107
Larval Aleurodidæ, The Vasiform Orifice of	220
Latas calcarifer (Bloch), On the food in cold season of	165
Leather Research Institute, Central	137
Leather Technology	102
Lebistes reticulatus (Peters), Acclamatisation of, in Madras	157
Lectureships, Madras University Endowment	62
Lettuce, Yellow Mosaic of	244
Lignites, Occurrence and Utilisation of	260
Linseed Oil, Substitute for	253
Liquid Fuel from Coal	225
Liquids, Heat Conductivity and Molecular Weight of	148
Luffa acutangula, Sex Inheritince in	359
Machinists' and Draftsmen's Handbook (*Rev.*)	60
Madras University Prizes	101
Magnetism, Modern (*Rev.*)	222
Magnetic Susceptibilities in Hydrates, Law of Additivity of	324
Malaria, Prevention of	134
Manganese Chloride Emission Bands	209
Mangifera indica L, A new Bacterial disease of	189
Marketing of Fish in Bengal	224
Marvels of Fish Life (*Rev.*)	373
Mathematics as a culture clue and other essays (*Rev.*)	61
—, Improving the position of, in India	35
Mathematical Instruments Office	36
Mathematicians, A challenge to	233
Mechanical Behaviour of High Polymers (*Rev.*)	308
Medical Congress, Tropical	139
— Libraries in India, Reorganisation of	312
— Training, Army	102
Medicine, Indian	171
—, Rationalisation of, in India	12
Medium of Instruction at University level	225
— — Studies in Colleges	80
Meson Tracks on Plates Exposed on the Nilgiris	210
Metal Films by evaporation	102
Metallurgical Laboratory, National	251
Meteorology, Tropical, Recent advances in	112
Milk, Change in nitrogen content of, on souring	25
—, Refractive constants of	213
Millions, Acclamatisation of, in Madras	157
Mineral springs of India	85
Minerals, Research in	62
Monazite, The home of, in the Vizagapatam area	296
Multi-Purpose project, Pipri Rehand Dam	146

	PAGE
Musca nebula F, Breeding of, for Biological Tests of Insecticides ..	301
Muscle, Unstriated, Active Elongation of	306
Mustard Embryos, A simple Method of isolating, and their Cultivation ..	29
Museums of the United States of America	285
Myrothecium roridium Tode Ex Fries, Occurrence of, on Cowpea in India ..	56
Mysore Geological Department Records (*Rev.*)	339
National Central Library for India ..	169
— Institute of Sciences: Awards ..	284
— — — of India, Elections	101
— Metallurgical Laboratory ..	251
— Research Professor of India ..	292
Natural Philosophy through the Eighteenth Century and Allied Topics (*Rev.*)	368
— Resources and Human adaptation (*Rev.*)	164
Network Analysis and Feedback Amplifier Design (*Rev.*)	192
New Lamps for Old (*Rev.*)	320
Nicotiana tabacum, Cytogenetics of ..	315
Nimblossoms (*Melia azadirachta*), A note on the Chemical Examination of ..	51
Nitration of 2-Nitro-Acet-Para-toulidide	239
Nobel Prize for Physics (1948) ..	323
Normal pressure profile, Variation in, in the neighbourhood of South America, the S. W. Monsoon in India and the Sun spots	81
Nuclear Physics in Calcutta University ..	169
Nucleic Acid antagonism of Penicillin Bacteriostasis	357
Nuffield Foundation, Endowments of ..	319
Numbers, Practical	179
Oil Position in India	283
Olympic Torch	283
Oncidium (*Rev.*)	339
One Story of Radar (*Rev.*)	335
One, two, three, infinity (*Rev.*) ..	222
Organo Arsenicals: Aryl Sulphonyl Esters of Hydroxyphenyl Arsonic Acids	89
Ovarial hormone, An insect tumour and ..	184
Paddy, A chromosome deficient type of	271
Pancreas-Glands, Preservation of, without refrigeration	293
Pasupalum scrobiculatum Linn—"Varagu"	367
Parasitism and superparasitism (Insects), Experimental studies on	269
Patent Laws, Committee for Review of ..	341
Pegmatites of Gosavid, Tiruvur Taluk, A Note on the occurrence of free sulphur in drusses and cavities of ..	149
Pellicularia filamentosa (Pat.) Rogers, Comb. Nov. Causing a rootrot of Berseem (*Trifolium alexandrinum* Linn.) in U.P.	270
Penicillin, Nucleic acid and Bactericidal action of	262
Pennisetum purpureum Schumach—the Dry Napier, Polyploidy in	153
Penaeid prawns breeding in fresh water	58
Personnel, Scientific and Technical, Roster of	108
Pests, Insect, of stored grains in Bombay Godowns	128
Phaseolus lunatus L., Yellow Mosaic of ..	152
Phenyl Thiourea, Constitution of ..	341
Phosphorus Assimilation of, during the decomposition of Plant Materials ..	364
Phosphanilic acid, Pharmacology of ..	125
Phosphorus, Far Ultra-violet Emission Bands of	119
—, Manufacture of, in India	103
Photography, Fundamentals of (*Rev.*) ..	131
Physical Science, The Growth of (*Rev.*)	97
Physicist and Teacher, Sir C. V. Raman as	343
Physiology of Man in the Desert (*Rev.*) ..	167
Phytopathological Examination of Seeds by Ulster method	266
Plaster of Paris from Sea-water Gypsum, A Note on the properties of ..	236
Pigeonites in certain Dolerite dykes near Robertsonpet (Kolar)	181
Pistillody in Saccharum	241
Plants, Chemical Composition of, as an index of their nutritional status (*Rev.*)	309
Plastic Material, A New	104
Plastics, The Science of (*Rev.*) ..	309
Plectranthus fruticosus (Benth.) Hook f., Correct name of	92
Pleurotropis foveolatus C of the Potato Beetle	154
Poisons (*Rev.*)	30
Polymers, High, Vol. III, Phenoplasts (*Rev.*)	97
Porcellanite stage of the semri series of lower Vindhyan in Jodhpur State, A note on the occurrence of ..	273
Potato tubers, Effect of Nitrogenous Fertilisers on the Respiration Rate of	124
—Necrosis	216
Power Engineering Laboratory ..	63
— Alcohol in India	102
— System Stability (*Rev.*)	279

	PAGE
Practical Numbers	179
Prizes, Elliot, for Scientific Research	62
Primes with maximum recurring periods for their reciprocals	261
Prohibition, The Scientific and Economic Aspects of	255
Protection of Nature Conference	374
Protazoa, Role of, in the concentration of Nitrogen in the sludge during aerobic purification of sewage	93
Psidium guava L., Internal breakdown of guava fruit	273
Public Health Commissioner with the Government of India, Annual Report for 1945	98
Purums, The: an old Kuki Tribe of Manipur (*Rev.*)	194
Quality control	63
Radar Detects Meteor Showers	103
—, Principles of (*Rev.*)	247
Radiation, Solar, A Proposed New Component of	20
Radioactive Isotopes, Allocation of	341
— —, Procurement of	232
Radio Cobalt as Cancer Cure	252
—, Noise, Surveying of Existing information and Data in, over the Frequency Range 1-30 MC/S (*Rev.*)	99
Radiolympia 1949	375
— Receivers & Transmitters (*Rev.*)	278
Rainfall, On estimating the average depth of, over an area & the distribution of raingauges	317
Rayon Manufacture, Cellulose-bearing materials other than cotton for	312
Rain, Winter, in South India	120
— — in U.P.	348
Ramanujan's Function τ (N), The Vanishing of	180
Rana tigrina Daud, A unique case of arterial abnormality in	218
— —, Abnormality in the venous system of	225
Rectifier: Contact Rectifier for low-voltage heavy currents	76
Recovery of oil from seed cakes of oil expellers, Note on	187
Refractive constants of whole and skim milk	213
Refrigeration of Foods	252
—, Popularising	252
Reliability of tests, A Note on	354
Research Institute of Leather	137
River Projects	135
Roccelin, The electrolytic preparation of	234
Rocks, Kemp's Handbook of (*Rev.*)	132
Royal Asiatic Society of Bengal	101
— College of Veterinary Surgeons	253
— Society Medalists (1948)	374
Saccharum, Pistillody in	241
Salt Range: A Remarkable Evidence of a Local Thrust Plane at the top of the Purple Sandstone Series in the Salt Range	296
— —, Punjab, Age of the saline series in (*Rev.*)	61
Salty Land, Using (*Rev.*)	309
Sandal, The Spike Disease of	141
Schiff's Bases of 4-4′-Diaminodiphenyl-sulphide	330
Scholars, Overseas	111
Scholarship in Mineralogy	32
—, Research (London Exhibition)	32
Science and Technology, Missions on	34
— Congress Association Elections	31
— Co-operation Office, South East Asia	169
— — — of the UNESCO	227
— News, 4 (*Rev.*)	161
— —, 6 (*Rev.*)	195
Scientific Conference, World	134
— Information Services	204
— Research Association (India)	31
— Research, Department of	251
Scientists are born and not made	232
Sea-water, Distilled, for Irrigation	103
—, Influence of, on Protozoal activity and purification of Sewage by the Activated Sludge Process	329
Scientists' Duty to the State	257
Seismology, An introduction to the Theory of (*Rev.*)	130
Sewage Purification by "Dilution," Role of Protozoa in	245
Sex Condition in interspecific cross: *Luffa ægyptiaca* × *Luffa acutangula*	275
Sexual Periodicity in Indian Birds	86
Silicon in Steels, Photo-electric Estimation of	363
Six-Sixty-Six (666), Trials with, against insects affecting grains in stores	127
Skin Diseases—A Manual for Practitioners (*Rev.*)	371
Sky, Overcast, The apparent shape of the moonlit	19
Smell, New theory of	28
Sodium Chloride, The use of, in the Determination of the Acid values of Cellulosic materials	88
Soil and Water Conservation in the Punjab (*Rev.*)	281

	PAGE
Soil Fertility, Earthworms and Insects in Relation to	324
Soil Research Station in Madras	32
Sorghum vulgare Pres., Ergot Sclerotia on	218
South Indian Diet, Effect of Tamarind and Chillies on	186
— — Science Association	104
Soya bean protein, Factors affecting the nutritive value of	52
Spectrum of Iodine—VII	362
Spot tests, Quantitative Analysis by	29
Squares of Numbers	209
Standardisation of Textiles	170
Standards Institution, Indian	63
States, Natural Resources of	104
Statistical Inference, Outline of some Modern theories of	84
Stature and Cephalic Index, The variations in, among Bengalee College Students	36
Sterculiaceae, Development of Embryo-sac in some	304
Strength of Materials, Elements of (*Rev.*)	247
Sugarcane Juice for the growth and distribution of some intestinal pathogenic bacteria, Studies on the suitability of	183
—, " Rayungan " method for speedy multiplication of seed material in	55
—, Sett roots in	124
Sugar Research, Award for	63
— — Foundation	196
Sulpha Drugs, Fifteen years of, A Perspective	77
Synchrotron, 30,000,000 volt	178
Synthesis of $\beta\beta$-dimethyl, $\beta\beta$-diethyl adipic and cyclohexane and cyclopentane - 1 - acetic-1-propionic acids	149
— —4-hydroxy -2- phenyl -3- acetylquinolines	333
Synthetic Mica, Development of	233
Tamarind and Chilli, Effect of Supplementation with, on the growth of young rats on a poor South Indian rice diet	51
Telephone Factory	225
Temperature, Viscosity of liquids and (*Rev.*)	214
Terpenes, The: Vol. I—The Simpler Acyclic and Monocyclic Terpenes and their Derivatives (*Rev.*)	100
Textile Finishing, An Introduction to (*Rev.*)	29
— Science (*Rev.*)	277
Thallium Iodide, Band Spectrum of	121, 182
Thermochor, A note on	365
Thunderstorms, Morning, at Cochin in the premonsoon season	122
Timbers of India, Commercial	293
Tonus in unstriated muscle	321
Trees and Shrubs, The identification of (*Rev.*)	193
Trace elements in Plants and Animals (*Rev.*)	29
Training Collges in Britain	135
Tropical Medical Congress	140
Truffle (*Tuber* sp.) from Kodaikanal	305
TTT-Curve data and their application	43
Turbines, Gas, Modern (*Rev.*)	100
Tuberculosis Association of India, The Eighth Annual Report (*Rev.*)	133
Ultrasonic Diffraction Patterns, Effect of increasing frequencies on	233
UNESCO Book Coupon Scheme	345
— Grants $7,500 to Council for Philosophy and Humanistic Studies	375
United Nations' invitation to Dr. S. L. Hora	375
University, Language Medium of Science in	107
University Education, Expenditure on	178
— Grants Committee	62
— Interchange between U. K. and India	351
Universities, Indian, Constitution of	105
—, Inter, Board	62
Uromyces acori Ramakrishnan and Rangaswami Sp. Nov. on *Acorus calamus* L.	240
Vacuum Practice, A manual of (*Rev.*)	132
Valency theory and the structure of chemical compounds (*Rev.*)	249
Vanaspati, Nutritional Value of	104
Velocity Modulated Thermionic Tubes (*Rev.*)	336
Vermiculite in Mysore	212
Vertebrate Anatomy, An introduction to (*Rev.*)	163
Veterinary Education (*Rev.*)	310
Viscosity of Liquids and Temperature	214
Vitamin D, Mode of Action of—A resume	173
—K, the 2:4-dinitro-phenyl hydrazine colour reaction for	22
Volvox in North India	240
Water, Heat Conductivity and Molecular Complexity of, Part II	215
Water Melon (*Citrus vulgaris*) Schrad and Food Poisoning	213
— and Food Poisoning	264
Wattle Bark, Indian	64

	PAGE
Weapons of World War II (*Rev.*) ..	221
Wheat grains, On some physiological properties of, extracts of	360
Wood Anatomy, pure and applied, Some aspects of	35
Wood Corrosion and Hot Chemicals ..	312
World Congress of Orientalists ..	226
World Cultural Co-operation ..	225
World Health Organisation, United Nations' Bulletin of (*Rev.*) ..	166
World Prospect of Food and Agriculture	313
Xanthomonas Desmodii-Gangeticii, Sp. Nov. Uppal, Patel and Moniz; a new bacterial leaf-spot of *Desmodium gangeticum DC.*	286
Xanthomonas malvacearum (Erw. F. Smith) Dawson on Exotic Cottons in India	243
Xenostele, A, on *Neolitsea zeylanica* ..	26
Yeasts, Autotetraploidy and attenuating power in	55
Yeast, A reverse mutation in, induced by ultraviolet irradiation ..	92
Yolk-sac in baby chicks, The pre-resistance of, due to Estrogen treatment ..	91
Young's Modulus	28
Ziziphus xylopyra (Wild.), Oil from the seeds of	150
Zoological Society of Bengal, Proceedings	282
— — — India	170
— Survey of India	342

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
208-49 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore.

(2·8 g.), benzidinec (1·15 g.), sodium hydroxide (0·5 g.), and sodium nitrite (0·9 g. in 150 c.c. of water, were electrolysed at a current density of 5 amps./dm.^{2} The anolyte did not develop any colour, even when the temperature was raised to 65°-70° C. A purple colour developed, however, when the run was repeated after adding twice the amount of sodium hydroxide (1·0 gm.). After the current was passed for the theoretical time, the anolyte was cooled and filtered in order to remove the unreacted benzidine. The filtrate was saturated with sodium chloride, and the dye separated as a flocculent precipitate. This was filtered at the pump, redissolved in a small quantity of water (50 c.c.) and salted out carefully, with good stirring, till the separation of the dye appeared to be complete. This procedure was follwed in order to remove a small proportion of the sodium salt of Nevile-Winther's acid which was also precipitated in the first stage. The precipitated dye was then filtered at the pump, sucked as dry as possible, dried in the air-oven and weighed.

Yield: 1·10 gm. or 25·7% of the theoretical. This dye gave a lilac shade on cotton dyed from a slightly alkaline bath.

It was felt that Congo Red could be obtained by employing the same conditions. The interfering reaction of sodium naphthionate could not of course be entirely suppressed; but some Congo Red was likely to be formed at the same time. This expectation was realised. The experiment was carried out with sodium naphthionate (3·06 g.), benzidine, (1·15 g.), sodium nitrite (0·87 g., and sodium hydroxide (1·00 g. in 150 c.c. of water). The conditions of electrolysis were the same as those already described for the previous preparation. The temperature was 60°-35° C. At the end of the run, the red coloured anolyte was cooled and filtered. The filtrate was boiled with 5 gm. of freshly ignited magnesium oxide for 20 minutes, cooled and filtered. The filtrate had a dark red colour, and on evaporation gave a reddish black powder which was very hygroscopic. This powder dissolved in water to give a red solution, which on treatment with dilute sulphuric acid turned purple, and a precipitate slowly formed. Filter-paper dipped in this solution turned red in colour, which became purple when touched with a drop of dilute sulphuric acid. This colour was entirely different from that given by Congo Red test paper. Evidently this powder was the dye reported by Brockman and Griffin, namely, 1-amino-1', 2-azo naphthalene disulphonic acid-4,4',

The residue was a chalky red powder. This was boiled with a small quantity of strong sodium carbonate solution in order to bring into solution any Congo Red that might be present as the magnesium compound. The reaction appeared to be very slow and only partial. The sodium carbonate solution was therefore removed and the residue transferred to a small beaker and treated with sufficient hydrochloric acid to neutralise the magnesium oxide completely. A very dark blue, almost black precipitate immediately formed. This was rapidly filtered at the pump, transferred to a beaker again and treated with a slight excess of sodium carbonate solution. A red coloured solution was obtained from which a dark red precipitate was formed on saturating with sodium chloride. This was filtered, sucked as dry as possible and then dried in the air-oven. A dark red powder which dissolved readily in water to give a brownish red solution was got. Filter-paper dipped in this solution had a bright red colour and turned blue when touched with a drop of dilute sulphuric acid. Cotton dyed from a slightly alkaline bath with this dye had a bright red colour, while silk and wool took on a brownish red shade. Yield of dye: 0·6 gm. or 14% of the theoretical. This dye is Congo Red, more or less pure.

This figure provides an interesting contrast to the yield when Nevile-Winther's acid was employed as the coupling component, and enables a rough idea to be gained of the extent to which the diazotisation of sodium naphthionate proceeds side by side with the tetrazotisation of benzidine.

It was not possible to improve the yield of dye by altering the conditions. An increase in the amount of alkali merely reduced the yield and no dye at all was formed in an excessively alkaline anolyte. Factors such as current density and temperature had no influence on the course of the reaction.

This method of preparing benzidine dyes is therefore restricted to such types where the coupling component has no diazotisable amino groups.

Presidency College, Madras, *November* 1, 1948.

V. V. RAMAN.
M. V. SITARAMAN.

1. Sitaraman, M. V., and Raman, V. V., *Curr. Sci.*, 1948, **17**, 234. 2. Brockman and Griffin, *Trans. Amer. Electrochem. Soc.*, 1939, **75**, 216. 3. Löb, *Z. Elektrochem.*, 1904, **10**, 237.

A PRELIMINARY NOTE ON DISEASES OF GRAM

THIS preliminary note deals with aspects of mineral nutrition of gram. From an examination of the gram plants of the Indian Agricultural Research Institute Farm in 1946-47 it was found that the diseased plants exhibited the following symptoms: (1) Top Yellowing, (2) Bottom Yellowing, (3) Yellowing and Bronzing, (4) Bronzing. A brief description of the above symptoms is given below. The disease was sporadic in distribution.

(1) *Top Yellowing.* As the name implies, the growing tips of the gram plants turn yellowish which are bleached to cream colour with age. It reduces the growth of the plants and consequently the yield suffers. The yellow colour disappears at about the time of flowering.

(2) *Bottom Yellowing.* The lower leaves first turn yellowish and progressively the top ones are affected. As the disease advances the plants show folded drooping leaves. Premature shedding of leaves also results.

(3) *Yellowing and Bronzing.* The symptoms of the disease at the early stage start with the bottom leaves. The colour is intermixed showing both bronze and yellow in the same leaflet. The top leaves show marginal bronzing in the beginning and later on the entire leaflets turn bronze. Thus while bottom leaves show both yellowing and bronzing, the top leaves show only bronzing.

(4) *Bronzing.* The bronze colour develops initially from the lower leaves, then affects other parts of the plant, progressively rising from the bottom. Within the leaflet itself the bronze colour is first seen on the margins, then on the base of the leaflet and finally on the rest of the leaflet. Among other features of the disease are retarded growth, dwarfing of the plants and decreased number of branches. Except in the case of "Bottom Yellowing" where fungal organism was found, the others were free from pathogenic organisms.

RESULTS AND DISCUSSION

The results of the chemical analysis of the healthy and diseased sample are given in the table. In this work the whole shoot was selected for analysis and each sample was composite of five healthy and diseased plants respectively, chosen at random. Three composite samples, each healthy, were also analysed.

The diseased plants in general seem to show a deficiency of boron as compared to healthy ones. Silica content in all the diseased plants is more than those of the healthy ones, the SiO_2 content being most marked in that of the "Bottom Yellowing". Other features of the nutritional disturbances as revealed through chemical analysis are given below.

Top Yellowing. The content of Mn is markedly less than that of healthy plants, the figure for the diseased being 63·6 p.p.m. and that of healthy being 153·5 to 101·3 p.p.m. Ash and P_2O_5 content is also higher than those of the healthy. There seems to be more iron and probably more molybdenum in diseased samples as compared to healthy ones.

Bottom Yellowing. Boron in diseased plants seems to be very low, being 15·6 p.p.m. while 31·3 to 36·4 p.p.m. have been found for the healthy. The plants contain excess iron, being 4104 p.p.m. for the diseased as compared to

TABLE I

Description of the sample	*Ash %	SiO_2 %	P_2O_5 %	K_2O %	CaO %	MgO %	B p.p.m.	Mn p.p.m.	Fe p.p.m.	Mo p.p.m.
1 Top yellowing. (D)	10·6 (h)	10·6 (h)	1·01 (h)	3·26	3·22	0·77	28·6 (h)	63·6 (*l*)	2133 (h)	5·3 (h)
2 Bottom yellowing. (D)	11·09 (h)	25·6 (*h*)	0·70	5·6 (*h*)	3·5	0·64	15·6 (*l*)	130·1	4104 (*h*)	5·5 (h)
3 Yellowing and bronzing. (D)	7·45 (l)	12·77 (h)	0·49 (*l*)	2·4	2·5 (l)	0·54 (l)	25·3 (l)	116·6	2623 (*h*)	2·5 (l)
4 Bronzing	7·7 (l)	8·4 (h)	0·35 (*l*)	2·0	3·1	0·78	25·96 (l)	94·8	1673	1·6 (*l*)
5 Healthy. (D)	9·19	7·6	0·69	2·7	3·5	0·84	31·3	158·5	1914	4·5
6 " (H)	9·4	6·1	0·55	1·9	3·6	0·72	31·7	118·4	1536	3·3
7 " (H)	8·8	6·1	0·60	3·2	3·3	0·71	36·4	101·6	1350	2·6
8 Average of healthy	9·1	6·6	0·61	2·6	3·5	0·75	34·1	126·2	1600	3·5

Note.—D = Diseased. H = Healthy. * Ash = Ash other than silica.

h and h signify respectively definitely a higher and possibly higher values than those of the healthy plants. and l similarly stand for definitely lower and possibly lower values.

1350 to 1914 p.p.m. for the healthy ones. There is also more ash, silica potash and probably molybdenum in the diseased plants.

Yellowing and Bronzing. These plants have a smaller content of P_2O_5 the figures being 0·49 per cent. for the diseases and 0·55 to 0·69 per cent. for the healthy. CaO and MgO as also Mo contents seem to be less in the diseased than in the healthy but the difference is small. Ash content is less in these samples.

Bronzing. These plants show an unmistakably low content of P_2O_5, the figures being 0·35 per cent. for the diseased and 0·55 to 0·69 per cent. for the healthy. Mo also seems to be deficient in these plants, the figure being 1·6 p.p.m. in the diseased as compared to 2·6 to 4·5 p.p.m. in the healthy ones. Ash content is less and the silica content though more than those of the healthy ones, the difference is not large.

The above observations represent the data obtained in 1947. The results so far obtained from the analysis of similar healthy and diseased samples as above during the year 1948 bear out the above conclusions.

"Bronzing and Yellowing" and "Bronzing" samples show similar low phosphate contents as compared to corresponding healthy ones.

Bronzing 0·46 P_2O_5% Healthy 0·82 P_2O_5%
Yellowing &
Bronzing 0·38 „ Healthy 0·53 „

Silica content in plants having the above symptoms also show similar higher figures as in the previous years.

"Top Yellowing" has been found to be associated with low manganese content this year (1948) also. The figures are shown below:

Healthy	96 Mn p.p.m.
Top yellowing	68 Mn p.p.m.

From the data presented above it appears probable that these are different diseases.

The authors acknowledge their indebtedness to Dr. J. N. Mukherjee, D.Sc., Director, Indian Agricultural Research Institute, for suggesting the problem, encouragement and valuable suggestions. Mr. K. F. Kheswalla kindly determined the presence of the Fungus organism.

Chemistry Division, S. C. Das.
Indian Agricultural D. P. Motiramani.
Research Institute,
New Delhi,
November 9, 1948.

ALKALI-SENSITIVE LINKAGES IN IRRADIATED CELLULOSE

An important development in the chemistry of cellulose in recent years has been the contribution of Davidson[1] on the degradation of certain types of oxidised celluloses by alkaline solutions. The concept of alkali-sensitive linkages *vis-a-vis* the (modified) cellulose molecule had its genesis in this work and has proved to be of great importance in assessing the value of the prevailing test methods for cellulose.[2] Precise information on the mode of sensitisation and removal of sensitive linkages is, however, lacking and this would warrant the need for a systematic study of the subject. In the course of a larger investigation on the mechanism of light attack on cellulose, which is in progress in these Laboratories, some evidence has been obtained on alkali-sensitive linkages in relation to irradiated cellulose, and it is the object of the present note to give a short account of this work and discuss the significance of the results.

Cellulosic material as represented by a piece of fresh, highly scoured cotton fabric was initially freed of any alkali-sensitive moiety by boiling repeatedly for eight hours with 1% sodium hydroxide solution. This was ensured by following up the degree of polymerisation (D.P.) during the process of boiling with alkali. The D.P. was estimated through the intrinsic viscosities of the corresponding nitrocelluloses in acetone solution, by employing the Mosimann[3] function. In a typical experiment, the following values were obtained for the D.P.

	Description of treatment	D.P.
1	Fresh fabric ..	2295
2	First boiling with alkali ..	1930
3	Second „ „ ..	1805
4	Third „ „ ..	1745
5	Fourth „ „ ..	1740

A piece of fabric subjected to the action of alkali as above was irradiated *uniformly* by a Hanovia High Alpine Sun Lamp during 24 hours, the fabric being at a distance of 30 cm. from the lamp. Immediately after irradiation, the fabric was divided into three pieces. All the three pieces ("A", "B" and "C") were stored under identical conditions in a cool dark place. Samples were drawn from each piece initially and at intervals and the D.P. of the basic cellulose material was determined. In the case of fabric "A", such determinations were on the samples as they were on these occasions. Immediately after the irradiation and prior to storage, fabric "B" was boiled with 1% sodium hydroxide solution for eight

hours; the subsequent determinations of D.P. were on samples drawn from the boiled fabric. Samples from fabric "C" were boiled with alkali immediately prior to the determination of D. P. The results of two representative experiments are given in the table below:

TABLE I

Degree of polymerisation during the post-irradiation period

No. of days after irradiation	Experiment I			Experiment II		
	Degree of polymerisation			Degree of polymerisation		
	"A"	"B"	"C"	"A"	"B"	"C"
1	1285	1187	..	1228	898	..
8	1181	1139	1090	1154	923	..
15	1126	1055	1051	..	..	923
22	1070	..	1070	1095	..	898
30	..	..	..	..	921	876
36	1048	1048	..	..	..	..
44	..	..	..	902	..	..
57	..	..	..	898	..	..

The results show that within the limits of experimental error, the ultimate value obtained for fabric "A" corresponds with the initial and all the subsequent values for the fabric "B" and the values of the fabric "C" at any stage. In other words, it would appear that the post-irradiation effect on the irradiated cellulose taking place in atmospheric oxygen and as affecting the D.P. is equivalent to boiling the irradiated cellulose with alkali.

Stillings and Van Nastrand[4] have reported *inter alia* that the action of ultra-violet light on cellullose is twofold. One of these results in the rupture of glucosidic linkages and the other merely *weakens* them. The weakened linkages break during post-irradiation period. Although it is by no means certain that the weakened bonds are necessarily glucosidic, the work described in this note, while confirming the general findings of Stillings and Van Nastrand, advances important evidence that the weakened bonds of irradiation are sensitive to alkali and that the slow post-irradiation effects in oxygen leading to the fall in D.P. of the cellulose can be replaced by boiling the irradiated cellulose in alkali.

A fuller account of the above work, as also a description of other aspects of the investigation on the mechanism of light attack on cellulose, will be shortly published elsewhere.

T. S. A. PADMANABHAN.
Tech. Dev. Estab. L. R. SUD.
Lab. (Stores), P. F. E. MANN.
Kanpur, S. K. RANGANATHAN.
November 22, 1948, T. S. SUBRAMANIAN.

1. Davidson, *J. Textile Inst.*, 1938, **29T**, 195. Brownsett and Davidson, *Ibid.*, 1941, **32T**, 25. Brownsett and Clibbens, *Ibid.*, 1941, **32T**, 57. 2 Unruh and, Kenyon, *Textil Research Journal*, 1946, **16**, 1. 3. Mosimann. *Helv. Chim. acta.*, 1943, **26**, 61 369. 4. Stillings and Van Nastrand, *J. Am. Chem. Soc.*, 1944, **66**, 753.

THE PREPARATION OF TRANSPARENT JELLIES OF ALUMINIUM MOLYBDATE

THE author in continuation of his previous work[1] on the preparation of several new jellies, has, for the first time, prepared the jellies of aluminium molybdate. The jellies have been prepared by the metathetical reactions between sodium molybdate and aluminium chloride solutions. 2 c.c. of the aluminium chloride solution (11·5%) are taken in test-tubes and varying amounts of the sodium molybdate solution (20·0%) are added. The total volume is kept 5 c.c. The test-tubes are shaken for about ten seconds and then are kept in a bath maintained at 25°C. The time of setting of the jellies are recorded.

Amount of 20% sodium molybdate (c.c.)	Time of setting (minutes)
2·4	60
2·2	70
2·0	80
1·8	100
1·6	120
1·4	150

These jellies are of the finest texture and are perfectly transparent when freshly prepared. They however have a tendency of gaining slight opalescence when kept for a long time. They are perfectly stable and do not undergo any syneresis. It will be seen from the above that the time of setting of the jellies depends upon the concentration of the sodium molybdate used. The time of setting is also greatly influenced by temperature. They set more readily at high temperatures than at low. They are thixotopic in nature and are very similar to thorium molybdate jellies prepared by Prakash,[2] by metathetical processes.

The author's thanks are due to Dr. Satya Prakash for his very kind interest in this work.

Chemical Laboratories, S. P. MUSHRAN.
The University, Allahabad,
December 20, 1948.

1. Mushran, *Curr. Sci.*, 1945, **14**, 200; 1946, **15**, 250. *Nature*, 1946, **157**, 95. 2. Prakash and Dhar, *J. Ind. Chem. Soc.*, 1929, **6**, 587.

CHEMICAL INVESTIGATION OF THE SEEDS OF *JATROPHA CURCAS* LINN.

Jatropha curcas is well known for its seeds which have purgative properties. It is also used in the case of Rheumatism and Itch. The juice of the plant is also reported to contain some colouring matter. As the plant is common in the Tropics, the juice and seeds have already been examined by various investigators.[1] The analysis of two indigenous samples from Malabar and Dharwar have been reported (*loc. cit*, Alimchandani and Menon) The plant is common throughout the country, but its seed-oil is not utilized for any industrial purpose. In Gujarat, the forest areas abound in these plants, so the seeds were collected from Rajpipla State and the oil and other constituents are being investigated in this laboratory with a view to find the suitability of the oil for industrial use for paint and textile purpose and whether the constituents contain any alkaloid.

The seeds were extracted with carbon tetrachloride for their oil content. The extract after complete removal of the solvent gave bright yellow oil, with not unpleasant smell, which was examined chemically. The yield is 44 per cent.

Jatropha curcas *obtained from Rajpipla State (Gujarat). Constants of Oil.*

S.P. Gr. at 29° C.	0·9440
Refractive Index at 27·5° C.	1·475
Saponification value	200·8
Acetyl value	16·5
Iodine value (Wijs')	88·0
Acid value	2·6
Acid value in terms of Oleic Acid	1·307
Unsaponifiable matter	1·1%
B.R. Reading at 40° C.	55·0
R.W. value	0·9
P value	0·1
Constants of Mixed Acids	
Iodine value	94·7
Saponification equivalent	287·7
Constants of Solid Acids	
Iodine value	2·9
Saponification equivalent	276·7
Constants of Liquid Acids	
Saponification equivalent	291·3
Iodine value	111·0

Per cent. of Saturated Acids is 26·5
Per cent. of Unsaturated Acids is 73·5

The further work as regards fractionation of different fatty acids methyl esters, the suitability of the oil for industrial purpose and the isolation of the alkaloids, if any, is in progress.

Chemistry Department, C. M. DESAI.
M.T.B. College, M. T. VYAS.
Surat,
December 16, 1948.

1. Alimchandani and others, *J., Univ. Bom.*, 1945, **14**, 34; Kartha and Menon, *Pro. Ind. Acad. Sci.*, 1943, **18**, 160; Cruz and West, *J. C. S. A.* 1947, **31**, 4518; Kafuku, *Ibid.*, 1933, **27**, **1**, 153?; Adriaens, *Ibid.*, 1936, **30**, 5440; Felke, *ibid*, 1914, **8**, 531.

THE DINITRATION OF META-CHLORACETANILIDE

IN connection with our studies of the factors involved in the elimination of the nitro-group during the diazotisation of certain nitranilines, it became necessary to prepare a pure sample of 4 : 6-dinitro-3-chlor aniline in quantity. This compound has been described by Nietzki and Schedler[1] and later by Fries and Roth[2] who both obtained it by the same method, *viz.*, the action of alcoholic ammonia on 4 : 6-dichlor-1, 3-dinitro benzene as yellow needles melting at 174° C. (Nietzki and Schedler) or 178° C. (Fries and Roth). Later, Nietzki and Zänker[3] claimed to have prepared it from 5-chlor-1, 2, 4-trinitro benzene by the same method. Since the methods mentioned above require the preparation of the intermediates themselves by the chlorination or nitration of suitable benzene derivatives, it was considered to be a more convenient and simple process to start with *m*-chloracetanilide and dinitrate it in one step to the required compound by suitable means.

In an earlier publication[4] it was mentioned that *m*-chlor acetanilide, when treated with a mixture of potassium nitrate and sulphuric acid was nitrated mainly in the 4-position (Cl=3) whilst the use of nitric acid as such resulted in an isomeric mixture of 4- and 6-mononitro-chloracetanilides which was extremely difficult to separate. Further nitration of either the isomeric mixture, or of the pure mononitro compound with the same but fresh reagent failed to give the desired dinitro compound.

According to Kehrmann and Stanoyevitch[5] when *m*-chlor acetanilide was added in small amounts to a well-stirred mixture of one part of nitric acid (1·52 d.) to three parts of

sulphuric acid (1·8 *d.*) kept at 0° C., only 4 : 6-dinitro-3-chlor-acetanilide resulted, but the yield was not specified. This was identified by the free amine (m.p. 174° C.—*cf.* N & S) liberated on hydrolysis with dilute sulphuric acid. On repeating this dinitration in the manner described, the desired product (m.p. 174° C.; acetyl derivative m.p. 136° C.) was obtained, but in an yield of only 10% mixed with an almost equal amount of the mononitro derivative, *viz.*, 4-nitro-3-chlor aniline (m.p. 157° C.—acetyl derivative m.p. 144° C.). A neat method of separation of these two nitro compounds has been worked out by us on the basis of the general principle that a dinitro benzenoid base was comparatively less basic than its mononitro counterpart and was therefore less liable to form soluble salts in acid media. In fact, when the crystallised product of dinitration consisting of a mixture of the acetyl derivatives of the mono- and dinitro chloranilines was hydrolysed using 50% dilute sulphuric acid, the mono-nitro base remained in the cold solution while the free dinitro base remained insoluble and could be filtered off and was found invariably to be pure—the mononitro amine could also be obtained pure from the filtrate by dilution with water and filtration.

The formation of both mono-and dinitro derivatives during the nitration in the manner described seems to have escaped the attention of Kehrmann and Stanoyevitch. However, the presence of monoderivative clearly shows that the dinitration is a two-stage operation and that, in the first place, the 4-position is occupied by the entering nitro group and it was only after that that the 6-position was attacked. The latter position is obviously more resistant towards nitration, as is indicated not only by the poor yield of the 4 : 6-dinitro body but also by the total absence of the 6-nitro mono derivative in the nitration products. It was thought probable that the non-completion of the nitration of the mono-nitro derivative to the dinitro stage was also partly due to the dilution of the acid mixture employed and its consequent ineffectiveness in attacking a position already resistant and made more so by the groups already existing in the molecule. A remedy for this appeared to lie in the employment of a mixture of nitric acid (1·52 *d.*) and fuming sulphuric acid (12% oleum); the dinitro compound was then observed to be the sole product of nitration, to the complete exclusion of the mono-nitro derivative. The yield of the required dinitro base was also found to have increased almost to double. Further, on repeating the same procedure, starting with the 4-nitro-3-chloro acetanilide, obtained by the nitrate-sulphuric acid mixture (yield 54%—*loc. cit.*), the same yield of dinitro base resulted thus furnishing further evidence for the two-stage character of the dinitration and also the possible explanation for the non-completion of the dinitration when the Kehrmann and Stanoyevitch acid mixture was employed. Further details will be published elsewhere.

Our thanks are due to the C.S.I.R., India, for a grant which defrayed the expense of this investigation and for permission to publish the preliminary results. We also record our thanks to Prof. R. D. Desai of the Department of Chemical Technology, University of Bombay, for a further gift of 100 gm. of *m*-chloraniline-HCl.

Chemical Laboratories, Presidency College, Madras, *January* 1, 1949.

B. B. Dey.
R. Krishna Maller.
B. R. Pai.

1. Nietzki and Schedler, *Ber.*, **30**, 1666. 2. Fries and Roth, *Ann.*, **389**, 311. 3. Nietzki and Zänker, *Ber.*, **36**, 3955. 4. Dey, Maller and Pai, *Curr. Sci.*, **17**, 239. 5. Kehrmann and Stanoyevitch, *Helv. Chim. Act.*, 1925, **8**, 663–8.

PRELIMINARY ANTIMALARIAL SCREENING TESTS OF SOME BIGUANIDE DERIVATIVES

A number of communications[1–5] have been published by us, on the synthesis of new potential antimalarials of the substituted biguanide type. The results of testing of some of these compounds against avian and simian malarias are now reported.

Avian Malaria Tests.—Although the synthetic compounds could be tested in a number of ways in the light of recent developments in the field of antimalarial testing[6,7] but for the present work as a preliminary screening test, only the suppressive antimalarial activity of the compounds against the blood induced infection of *Plasmodium gallinaceum* in chicks, has been evaluated. Young cross breed country fowls, 8-10 weeks old, were infected intramuscularly with citrated blood freshly drawn from control birds showing peak infection. The size of the inoculum was so adjusted that the control group showed peak infection after 8-10 days invariably. Treatment group was orally fed with the requisite

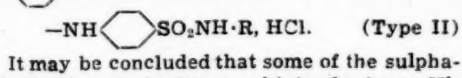
dose of the drug (in aqueous solution or suspension) twice daily for four days after 48 hours of infecting. After the treatment was over the blood smears were examined daily and the delay in reaching the peak infection in the case of drug treated group of birds in comparison to that of control was taken as criteria for the suppressive antimalarial activity. The antimalarial activities given below are with respect to paludrine which has given the maximum time lag between the peak infection of control and treated groups.

X.NH—C (=NH)—NH—C (=NH)—NH.R, HCl (Type I)

TABLE A. *Analogues and isomers of paludrine.*

No.	X	R	Dosage mmg./100 gm. body weight	Activity
1	*p*-Chlorophenyl	Isopropyl (Paludrine)	6	+++
2	do	do (acetate salt)	6	+++
3	*p*-Fluorophenyl[4]	do	20	+(toxic)
			4	−(toxic)
4	*m*-Chlorophenyl[4]	do	20	++
5	2 : 4-Dichlorophenyl[4]	do	40	−(toxic)
			20	−(toxic)
6	do	Methyl-propyl	4	−(toxic)

Metachloro analogue of paludrine (No. 4) has shown good activity while the fluoro analogue has been found to be inactive and toxic. The presence of an additional chlorine atom in the p-chlorophenyl ring of paludrine has also not led to active compounds (No. 5,6). In the case of toxic compounds, most of the treated birds died during or just after the treatment and on disection showed Hæmorrhage in the gizzard and congestion in the gullet indicating local iritation.



(Type II)

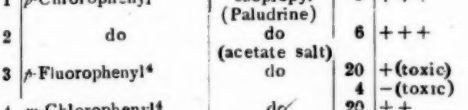
It may be concluded that some of the sulphabiguanide derivatives obtained from N'-pyrimidyl-sulphanilamides showed good suppressive antimalarial activity when tested at relatively large dosage. This suppressive activity is however not comparable to that of quinine or paludrine. Toxicity of compound No. 17 was determined in mice. Sulphabiguanides did not form metallic complexes

TABLE B. *Sulphabiguanides.*

No.	X	R	Dosage mmg./100 gm. b. wt.	Activity
7	Cl[3]	H	6	−
			12	−
8	CH_3O	H	6	−
			12	−
9	Cl	2-thiazolyl[1]	20	−
10	Br	do	40	−
11	H	2-pyrimidal	40	++
12	Cl	do	40	+
13	Br	do	20	−
14	CH_3O	do	20	++
15	NO_2	do	20	−
16	Cl	6-methyl-2-pyrimidyl[2]	40	++
17	Cl	6 : 4-dimethyl-2-pyrimidyl[2]	40	+(toxic)

(chelates) and activity in the case of these compounds shows that for antimalarial activity a suitably substituted biguanide group may be sufficient, apart from other considerations.

X.NH—C(=NH)—NH—C (=NH)[5]

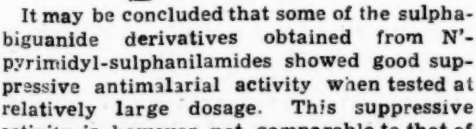


(Type III)

TABLE C. *Meta-chloridine substituted aryl biguanides.*

No.	X	Dosage mmg/100 gm. b. wt.	Activity
18	*p*-Chlorophenly.	40	++(toxic)
19	2 · 3-Diemthyl phenyl.	20	+

Although the above group of compounds showed suppressive antimalarial activity, compound No. 18 was found to be toxic at the above dosage. Compound No. 19 was however found to be non-toxic at this dosage when tested in mice, but was relatively less active Metachloridine substituted arylbiguanides resemble sulphabiguanides as regards their activity and chelating capacity.



(Type IV).

Compound (IV) (No. 20) when tested at a dosage of 40 mmg./100 gm.b. wt. was only found to be slightly active and excessively toxic. Replacement of isopropyl group by thiazolyl

ring in the paludrine molecule does not seem to result in active compounds.

Simian Malarir Tests.—Some of the compounds reported above were also tested against blood induced infection of *Plasmodium knowlesi* in Rhesus monkeys at the Malaria Institute of India for assessing their preliminary suppressive activity.

m-Chloro analogue (No. 4) and p-bromo analogue (Type I ; X = p-bromophenyl) of paludrine have shown encouraging suppressive activity. In the sulphabiguanide series, compound No. 7, 9, 11 and 17 have been found to be inactive while compound No. 16 as well as bromoanalogue of compound No. 7 (type II ; X = Br) have shown encouraging suppressive activity. Compound No. 18 and 20 have also failed to show any noteworthy activity.

These results are generally in agreement to those obtained in the case of avian malaria screening tests.

Our thanks are due to Dr. K. P. Menon for his keen interest and valuable help. Authors also wish to thank Director, Malaria Institute of India for the simian malaria tests and to the Indian Research Fund Association for the award of a fellowship to one of them (H. L. Bami).

H. L. Bami.
S. Natarajan.
Pharmacological Labs., A. S. Ramaswamy.
Indian. Inst. of Science, N. N. De.
Bangalore 3, B. H. Iyer.
February 10, 1949. P. C. Guha.

1. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1947, **29A**, 15. cf. *Curr. Sci.*, 1947, **16**, 251. 2. —, *Ibid.*, 1948, **30A**, 1, cf. *Curr. Sci.*, 1948, **17**, 90. 3. —, *Ibid*, 9, cf. *Nature* 1948, **162**, 146. 4. Bami and Guha, *ibid.*, 1949, 31A (in press), *cf. Curr. Sci.*, 1948. **17**, 272. 5. —, *Sci. and Culture* (in press). 6. Wiselogle, "A survey of antimalarial drugs. 1941-45," Vol. I. 7. Curd, Davey and Rose, *Am. Trop. Med and Parasitol.* 1945, **39**, 139. 8. Curd and Rose, *Nature*, 1946, **158**, 707.

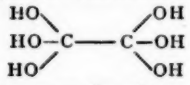
INFLUENCE OF HYDROXYCARBOXYLIC ACIDS ON THE REACTION BETWEEN α-NAPHTHYLAMINE AND DICHROMATE AND α-NAPHTHYLAMINE AND VANADATE

The catalytic influence of the oxalate ion on the reaction between hydriodic acid and dichromate,[1] hydrobromic acid and dichromate,[2] aromatic amines and dichromate,[3] hydriodic acid and vanadate,[4] and aromatic amines and vanadate[5] has been previously reported.

van Eck[6] has developed a colorimetric test for dichromate. According to him, addition of a trace of α-naphthylamine to a solution of potassium chromate and subsequent acidification with tartaric acid produces an intense blue coloration. He claims that the reaction can be used for the colorimetric estimation of dichromate.

Experiments now carried out have shown that the action of tartaric acid is mainly catalytic and not due to its hydrogen-ion concentration, since no color was produced when sulphuric, hydrochloric and acetic acids were employed for acidifying the solution. Moreover, other hydroxycarboxylic acids like citric, lactic and malic acids were found to catalyse the color reaction. Oxalic acid, though a carboxylic acid, is found to be more active than even the hydroxyacids. Vanadate also produces a blue color with α-naphthylamine under similar conditions.

This peculiar property of oxalic acid can be satisfactorily explained by the theory of Bergel,[7] who suggested that oxalic acid in its hydrated form can be represented as a polyhydroxy compound with the structure



Details will appear elsewhere.

Chem. Lab., M. Narasimha Sastri.
Andhra University, J. V. S. Ramanjaneyulu.
Waltair,
January 27, 1949.

1. Viswanadham, C. R., and Gopala Rao, G., *Curr. Sci.*, 1942, **11**, 102. 2. —, *Ibid.*, 1943, **12**, 186. 3. —, *Ibid.*, 1944, **13**, 47. 4. —, *Ibid.*, 1943 **12**, 229. 5. Narasimha Sastri, M., *ibid.*, 1943, **17**, 327. 6 van Eck, P. E., *Chem. Weekblad.*, 1915, **12**, 63. 7. Bergel, F., *University of Leeds Magazine*, 1944.

A PRELIMINARY INVESTIGATION INTO THE VIABILITY OF IMMATURE EMBRYOS OF CORN UNDER CONDITIONS OF COLD STORAGE AT FREEZING POINT

In any investigation involving embryo culture requiring the dissecting out of several hundreds of embryos from immature kernels of corn (maize) or other plants, any method that helps to preserve the young embryos from loss of viability should have a special significance in that such an operation could then be conducted through several days or longer, without being obliged to do it all at one moment. The present

investigation was conducted to see if cold storage at freezing point would help to preserve the viability of the immature embryos of corn and if so, for how long. A 3-week-old corn cob from an inbred stock, with husk in tact, was placed in the refrigerator immediately after harvest on August 31, 1947. The embryos were dissected out of their kernels and daily tested for viability in Tukey's culture medium from the time the kernels were kept in the culture medium and continuing until the embryos showed no sign of viability. The kernels were plump at the time of keeping in the refrigerator. After five hours they had already shrunk at the bottom. A sort of dryage was evidently in progress. After a week they were distinctly shrunken. At the end of twelve days they had practically flattened out and the borderline of the embryo was clearly thrown out to view at the anterior surface of the kernel. At the end of sixteen days the seed coat had become as hard as that of a matured seed. Thereafter the dissecting out of the embryo became difficult. Ten embryos were tested each time. They showed hundred percent. viability till the sixteenth of October 1947. Thereafter there was a steady decline in the viability. None of the embryos kept on the 26th of October germinated, while only one out of ten excised on the 25th of October germinated. Hence the period of viability for a 3-week old embryo kept in cold storage at freezing point, appears to be approximately a month and a half. The period, however, may not be the same for older or younger embryos.

In the present investigation, however, the embryos were obtained from a single ear. To confirm the result, embryos should be tested from more than one ear and the test repeated.

Agri. Res. Institute, P. UTTAMAN.
Coimbatore,
January 19, 1949.

1. Tukey, H. B., *Proc. Am. Soc. Hort. Sci.*, 1934, **32**, 313.

RESEARCH INFORMATION SERVICE

RESEARCH INFORMATION SERVICE, established translators of foreign scientific and technical material, have introduced a new and much-needed service by cataloguing and preparing translations of articles from *current Russian techrical and scientific publications.*

Although Soviet presses pour out hundreds of magazines and reports covering an enormous range of subjects, the greatest portion of which are being imported into this country, only a very small percentage of this material has been of practical value heretofore because of the lack of qualified translators and the exorbitant cost of technical translations.

Pioneers in this field, Research Information Service has undertaken to catalog the material received in this country—comprising tons of printed matter on Russian scientific and industrial activity—and then to screen and translate and publish at reduced cost—at a fraction of the cost of "made-to-order" translations—that information which is of most immediate interest to American industry.

For this purpose Research Information Service maintains a staff of qualified linguists, editors and translators, trained expressly for scientific and technical work.

Translations immediately available—listed in Research Information Service Bulletin No. 27-deal with problems in the petroleum industry. The Bulletin lists translations on such subjects as *Problems of High-Speed Drilling, Problems and Methods of Medium-Speed Oil Products, Pressure Heads in Oil Bearing Formations and Rates of Flow, the Solubility of Natural Gas in Petroleum, the Boiling Temperatures of Olefins, Studies on the Inflammability of Gases, Convection and Inflammability in Ether-Air Mixtures,* etc.

At present the company is preparing Bulletins listing translations of articles in fields such as metallurgy, agricultural chemicals, medicine, aeronautics, machinery and several others. These Bulletins will be made available to industry in the very near future.

Special arrangements for translations of foreign language material now in the hands of individual companies can be made through the *Industrial Translation Division* of Research Information Service, whose sales-translation plan has already gained widespread acclaim.

Translations and Bulletins listing translations may be obtained from the publishers, Research Information Service, 509 Fifth Avenue, New York 17, N.Y.

REVIEWS

Spectroscopy and Combustion Theory. By A. G. Gaydon. (Chapman & Hall, Ltd.), 1948. Pp. 242. Price 25*sh.* Net.

As is well known, the history of the progress of chemistry is knit closely with the study of combustion. In flames where reactions are running fast, the spectroscope has played an important role in revealing some of the constituents of flames. In many cases it has provided quantitative information about the mechanism of flame reactions and has also helped in the measurement of the temperature of flames. In recent years spectroscopy has made an important contribution to combustion theory. In the present monograph, Dr. Gaydon has collected together what the spectroscope tells about flames. It is a revised edition of the book first published in 1942, and embodies the many recent developments in this active field of research. Large sections have been added and others have been entirely rewritten.

After a general introduction to the subject, the author gives an elementary treatment of the theory of molecular spectra in Chapter I for the benefit of those who have not had a specialised training in spectroscopy. The presentation has been made as simple as possible with special emphasis on the practical applications of the subject. In the second chapter which is on emission spectra, the conditions under which they appear and their interpretation are fully discussed. Stress is laid on the quantity and the quality of light emitted. This Chapter therefore provides the theoretical background for understanding many of the quantitative investigations discussed in later chapters. The experimental aspects of the study of emission spectra are also briefly dealt with in the same chapter.

The next six chapters deal with the results of the study of the emission spectra of various flames and explosions such as the hydrogen flame, the hydrocarbon flames, cool flames and atomic flames, etc. The probable emitter and the significance of the hydrocarbon flame bands are discussed fully. The origin and nature of the flame spectrum of carbon monoxide is treated at some length in Chapter IV. These chapters also include a brief report of the investigations of the spectra of cool flames, explosion flames and of the internal combustion engine. Chapter IX is devoted to the subject of continuous spectra. It also deals with the nitric oxide test for atomic oxygen in flames.

The study of absorption spectra is potentially a very powerful method of investigating the progress of slow combustion processes and chemical reactions in the gas phase. This subject is considered in some detail in Chapter X. A critical discussion of the advantages and limitations of absorption spectra for studying combustion problems included in that chapter is extremely useful. It is well known that quite an appreciable part of the energy radiated by flames falls in the infra-red region. Chapter XI describes the numerous investigations carried out on the spectra of flames in the infra-red region. There seems to be an intimate relationship between the infra-red radiation and the after-burning and the so-called latent energy of the combustion. This is fully borne out by the results of numerous researches carried out by Dr. Gaydon which are briefly discussed in Chapter XIII.

In Chapter XII entitled "The lifetimes of activated molecules" are described the methods by which the radiative and collision lives of activated molecules may be determined. The available data on actual molecules are also mentioned and discussed. Chapters XIV and XV deal with two important topics, namely, flame temperature methods for their measurement, and dissociation energies respectively. In addition to the results obtained from the studies of the emission and absorption spectra of flames, spectroscopy has contributed to the quantitative side of combustion theory in many ways. Some of these are discussed in these two chapters which deal with the calculations from spectroscopic data of specific heats, energies of dissociation, etc. In the concluding chapter entitled "Kinetics of Spectroscopy" the author summarises the present contributions of spectroscopy to combustion theory and gives some pertinent suggestions regarding the lines along which the application of spectroscopy to the theory of combustion may be developed most profitably. He has pointed out the need for quantitative rather than qualitative observations and the importance of the use of spectroscopic data in following the kinetics of the combustion process.

In the Appendix are given some details which would be useful for the recognition of spectra frequently encountered in combustion work. A list of the chief characteristics of flames, data on atomic and molecular energy levels and physical constants are also included in the Appendix. A fairly complete bibliography containing more than 300 references to original publications on the subject is also appended.

The present monograph has been written by one who has himself made many notable contributions to the technique of flame spectroscopy and molecular spectrum analysis and can therefore be considered as an authoritative report on the subject. It is the only work solely devoted to the subject. As the author has attempted to cover the whole field of the applications of spectroscopy to combustion theory fairly fully, many topics have been presented in a condensed form. The treatment is also not mathematical. It can be easily understood by anyone who is familiar with the elements of spectroscopy. As Sir Alfred Egerton says in his Foreword, " Many will find useful a book which collects together what the spectroscope tells about flames ".

R. S. K.

History of Dyes and Dyeing in the Bombay Presidency. By B. N. Phadke. (Published by Messrs. Dastane Bros. Home Service, Ltd., Poona City). Pp. xx+152. Price Rs. 12.

Once in a way, it will act as a good mental tonic to read through books of ancient glory in arts and crafts. The present historical account of dyes and the art of dyeing is no exception to this rule. One will be surprised to find how people, in those days of comparative ignorance and superstition, developed the art of dyeing to such scientific perfection. Fermentation technique was employed for the preparation of indigo white without knowing that yeast was responsible for fermentation. Bark extracts were employed to mordant textiles without knowing that tannin was the mordanting agent. These were the achievements of great concentration and experimentation.

The volume under review, gives a lucid historical survey of the dyes used in the Bombay Presidency and the methods employed for their application to textiles right from the old village dyer to his counterpart in the process textile mills. The first chapter gives the historical background of the dyeing from the Vedic times to the present period. The great skill of the ancients in the presentation of hue, shade and tint has been described in detail. The second chapter deals with the development of indigenous dyes in the Bombay Presidency and indicates the adverse effect of the introduction of the synthetic dyes on the indigenous ones. The application of indigenous dyes to cotton, silk, wool, ivory, wood and leather is discussed in detail. The third chapter gives a good account of the application of mineral pigments on textile fibres. The fourth chapter is the most important one since it gives the details of application of synthetic dyes to various textiles. Application of synthetic dyes to miscellaneous purposes such as yarn printing, writing inks, food colours, wood and paper colours, etc., has also been fully indicated. The fifth chapter is devoted to a comparison of synthetic dyes with the indigenous ones and the author comes to the inevitable conclusion that indigenous dyes can never compete with the synthetic ones. The Appendix deals with the history of the development of Dyestuff Business, details of production and composition of vegetable and animals dyestuff of the presidency and various other useful tabular data. The author has to be specially congratulated on winning the 'Ashburner' prize for the compilation of this volume.

M. R. A.

Principles of Biological Assay. By C. W. Emmens. (Chapman & Hall, Ltd., London), 1948. Pp. xv + 206. Price 21*sh.*

In this book the author discusses statistical methods of interpreting experimental results and gives formulæ to be used in determining the accuracy and adequacy of experimental findings. He has given many examples of experimental results together with calculations necessary for the purpose of assigning limits within which the potency of preparations may be presumed to fall in comparison with a standard. The variation between animals is very great and in order to allow for the differences it is essential to plan experiments carefully and to determine how far differences between groups are due to the factors which are being studied. Throughout, the author lays stress on the proper use of modern statistical methods.

The introductory chapter discusses the application of mathematics to biological measurements. Later on certain principles of

design are illustrated and subsequent chapters deal with the randomised block and the latin and higher square designs. New and complex extension of these to the factorial design and to the value of concomitant measurement in design are also treated. Particular attention has been drawn to the necessity of a valid estimate of experimental error.

The book satisfies the requirements of sound and intelligible experimental design and supply the machinery for unambiguous interpretation. The examples chosen in the book are aimed at illustrating the principles of successful experimentation. It is a very useful book for exact tests of significance and fully illustrates the variety of computational procedures. The book will be of great interest and value to the research workers and students of pharmocology and experimental therapeutics and to analysts.

N. N. De.

The Grasslands of Latin America. By G. W. M. Roseveare. (Published by the Commonwealth Bureau of Pastures & Field Crops, Aberystwyth, Great Britain), August 1948. Price 20/-.

This is a very comprehensive publication which brings together a vast quantity of information regarding the grasslands of Latin America, both the natural grazing areas and the pastures and leys. The countries covered comprise more than a continent, extending from Mexico in the north to Patagonia in the extreme south, the whole indeed of Central and South America. The diversity of environment in this vast area can easily be imagined. Differences in soil, altitude, temperature, rainfall and snowfall, proximity to the coast or otherwise, mountain pastures, treeless plains, flooded riverbanks, eroded surfaces and so on, with their distinctive grass flora and their peculiarities as fodder—all of these give rise to a formidable variety in the material dealt with. As the Preface states, huudreds of books, journals and occasional publications, many of them written in foreign languages, have been laid under contribution and a vast array of information brought together. Practically every conceivable aspect of the subject is gone into and the book is a veritable mine of interesting and valuable information. Surveys according to the climatic zones and under three classes such as tender, strong and hard grasses, their distinctive characters, floristic composition, the role of lucerne and other leguminous vegetation, productivity of the grasslands, soil surveys and a correlation of the nutritive value of the herbage with the type or composition of the soil, the relation of legumes in kind and bulk to the soil, soil degradation and grass cover and many similar subjects relating to the grasslands of each State come under this section. Many of the surveys are interesting in that a large number of Indian grasses figure among them, even the dominant grasses being the same. Under temporary leys are dealt with very interesting subjects like cultural technique, seed production, breeding of new varieties, growth habits, out-turns, chemical composition, feeding value and palatability, feeding trials and other matters, relating to each one separately, of lucerne leys, other leguminous leys, cereal and other mixed grass leys. Some noteworthy material in this section, among other things, is the work on the toxicity of some sorghums (a familiar trouble in India) and the seed production of lucerne, in which it is stated that seed from dry land lucerne is preferred to that from irrigated lucerne though the latter seeds in abundance. A list of shrubs and trees of fodder value (called, 'brouse' plants) with botanical names and descriptions, including those which are believed injurious or even poisonous comprises another chapter. We note that studies are in progress and that some success has been attained in breeding sorghum varieties with a very low hydrocyanic acid content.

A most interesting chapter is the one on soil erosion, and conservation, not only on grasslands but also in the extensive coffee plantations.

Many veterinary problems connected with grasslands are dealt with in another chapter; these include deficiency diseases (like osteomalecea), remedical measures, the tick scourge and its control (which is particularly valuable as a matter affecting most Indian pastures) locust invasions, fungus parasites, weed infestation (among which figures our familiar friend, *Cyperus rotundus*) and other matters. In the chapter on grassland management which follows is given a useful resumé of the case for and against the annual burning of grasslands, a practice also familiar in India. The last chapter describes the scientific research and experimental work in progress in all the different States, the scope of which should be an eye-opener to many of us. We have nothing but unstinted praise for this excellent book, which ought to find a place in every agricultural library.

A. K. Y.

FUGITIVE MOLECULES

THE last quarter of a century has witnessed considerable change in our concept of the nature of a chemical bond and an important contribution in this development has been the discovery of a number of labile molecules some of which had extremely short life. Studies in reaction kinetics have been not a little responsible for bringing such molecules to our notice. The Faraday Society Discussion on Free Radicals in 1933 covered only the preliminary exploratory work while the discussion on Oxidation in 1945 dealt with one aspect of the problem. A fuller discussion is thus a necessary sequel and the report of the Discussion on "Labile Molecules" in 1947* which has recently been published is a welcome contribution.

The report includes papers under four broad subdivisions: Theoretical, Gas Phase, Liquid Phase, and Polymerisations. The theoretical part is naturally the shortest section. It is now well recognised that in the distinctions between the different carbon compounds, the bonds formed by carbon involve a certain amount of hybridisation, with a continuous interplay of *s* and *p* in varying proportions, the total of *s* and *p*, however, being maintained constant. The special configuration around a central atom is primarily governed by the extent of hybridisation. The nine papers in this section cover the ground using both the molecular orbital and the valence bond methods. The opening contribution by Coulson gives a concise review of the present position of the theory bringing out clearly the inherent difficulties. The fundamental character of a free radical is the presence of an unpaired electron and the distinction between the different free radicals lies precisely in the position and degree of localisation of this electron. Difficulties are inherent in any quantitative evaluation of this aspect which is essential in any interpretation of reactivity but the results obtained are none the less useful. Walsh's contribution is a logical development of the fundamental principle enunciated at the beginning of his note 'The more *s* character in a carbon valency, the more electronegative is the carbon atom in that valency'. Daudel and co-workers have made effective use of the valence bond method in the shape of a molecular diagram with the bond lengths defined by a mobile bond order termed by them "*indice de liaison*" while homolytic activity is defined by free valence "*indice de valence libre*". An extended table for a number of aromatic free radicals with the diagrams is a useful contribution for use in calculations of reactivity. The picture of π-complexes given by Dr. Dewar is no doubt an attractive one but much more than the evidence given is needed before it can be accepted in full. Any picture of chemical reactivity without reference to the energy of the transition state must necessarily be inadequate. It would be also interesting to see if the rather unorthodox formulation of cyclopropane and of ethylene oxide help in accounting for some of the abnormalities of the Raman spectrum of these compounds.

The final picture one gets is that in spite of some advance in quantitative interpolations, theoretical development has not been able to indicate any fresh qualitative principles for further experimentation.

A group of thirteen papers cover the ground of gas-phase reactions, the bulk of which deal with the labile molecules in hydrocarbon reactions. Both spectroscopic and kinetic investigations have revealed that there are relatively few simple polyatomic labile molecules. Band spectra are known for CHO, NH_2 and CH_2 and Gaydon has added BrO and CBr. As Hinshelwood remarks in his introduction, a good deal of chemistry will have to be rewritten if the existence of the labile molecule HO_2 is not postulated but one has to accept the position that the objections raised over ten years ago on the use of a semi-empirical method for quantitative evaluations still hold good and the quantitative evidence in support of this postulated molecule makes use of only this mode of approach.

The chemical reactions of hydrocarbons can be considered under the heads: Decomposition into free radicals, reaction of free radicals or of atomic hydrogen or other similar element with hydrocarbons and other free radicals and oxidations. Steacie has brought out the need for further work on atomic hydrogen-hydro carbon reactions while Watson has brought out the differences in C-H bond energy with progressive substitution at the carbon atom by alkyl groups. Oxidation reactions naturally figure prominently in the discussion as this involves unstable intermediates and emphasises the trend of kinetic studies in ignoring the stoichiometric equation and considering only stages in the mechanism each of which involves only a few atomic

* *Discussions of the Faraday Society*, 1947, Number 2.

movements of the simplest character. The observations of Partington on the pyrolysis of hydrocarbons do not conform, as may be expected, to the theory that the energy of vibrational degrees of freedom can contribute to the activation energy. The pyrolysis rate constant appears to be practically constant when the number of carbon atoms in the chain exceeds 6. In contrast to this, oxidation appears to rapidly increase with the length of the hydrocarbon chain. The course of oxidation seems to be on the lines expected for a Semenoff 'degenerate branching chain' mechanism. It is obvious that further work is necessary for a full understanding of the problem of oxidation of hydrocarbons in the gas phase.

Minkoff has critically examined the problem of the radical HO_3 in the gas phase and has applied Eyring's method to the reaction system which appears to indicate a trough in the reaction co-ordinate corresponding to the formation of this radical as an intermediate. Contrary to other observations, Chara claims to have isolated a compound of the formula H_2O_4 by cooling the products of an electrodeless discharge but this requires confirmation. Spectroscopic evidence is lacking and one awaits with interest the results of an infrared study referred to in the paper. Gaydon has been able to obtain radical spectra by a simple device for the study of flame spectra of low pressure flames and is besides able to indicate possible mechanisms for the formation of these radicals. One result of these investigations is the report of additional labile molecules.

Reactions in solution naturally occupy an important section of the discussion and the last ten years have shown the wide occurrence of free radicals in a variety of homolytic and heterolytic reactions. Waters finds that persulphate oxidations and oxidations with Fenton's reagent can be adequately represented by a simple chain mechanism involving hydroxyl radicals. One needs much more than the evidence of chemical reactions before accepting the statement "The exact formulation of the alcohol radical is a moot point particularly since *the possibility of tautomerism must be conceded*" (italics mine). I should also consider that it is not safe to conclude only from the relative velocity constants that aldehydes react in the hydroxylic form. Weiss' report of "Active" oxalic acid is a significant contribution on the oxidations using permanganates and one can safely add $C_2O_4^-$ to the list of known free radicals.

The contribution on the decomposition of silver alkyls only serves to indicate that much more has to be done in the study of these organometallic compounds before any generalisations are possible.

It is difficult to agree to Dr. Mann's definition of a free radical as "a neutral group of combined atoms one of which possesses a deficiency of electrons so that the groups can combine in pairs". This definition implies that any monomer which readily forms a dimeric molecule should be termed a free radical and the term can be held applicable in such a case to compounds like aluminium chloride or bromide, aluminium trimethyl and formic acid! The experimental fact that is referred to certainly needs explanation but not by such devious definitions.

While transient intermediates have been postulated in several reactions, their short life makes it very difficult to prove their presence by other methods. The contribution by Denbigh and co-workers is quite a welcome one in indicating a method of using of flow technique to maintain a steady state so that transient intermediates can be examined, even though the concentration is small.

The last group of fourteen papers cover different aspects of the phenomenon of polymerisation in which free radicals play quite a significant part. N-nitroso acyl aryl amines are found to be efficient catalysts in initiating polymerisation, the products formed by their decomposition into free radicals being invariably found in the final polymer. Dr. Magat's report during the discussion of a nonphoto-chemical temperature independent method of producing free radicals by using the Sziilard effect is an indication of a fruitful new line of approach to the problem. Dr. Mayo's contribution on copolymerisation clearly brings out that a terminal ethylenic bond with conjugated unsaturation is an important factor in reactivity but at the same time, the reported results indicate how other factors have also to be taken into account. The influence of a substituent on styrene polymerisation is found to be analogous to that of polar substitution reactions but in carbonyl conjugated compounds the influence appears to follow a different order, a feature not surprising in the complex field of free radical kinetics. Price's interesting analysis of the problem enables him to separate copolymerisation ratios, where there is no complication of a disturbing steric factor, into a 'polar' factor and a 'general monomer reactivity' factor. While the role of solvent in reaction

kinetics is still not fully understood, in the field of polymers it has been clearly established that they take part in chain transfers and the influence of a solvent is quite marked. Bamford and Dewar's papers provide further evidence of this phenomenon. An analysis of the group of papers shows that the activation energy of these reactions involves not only the resonance energies of the radical initiating the reaction and of the monomer and the nature of the repulsion energy but also the resonance energy of the transition stated. The solvent influence in chain transfers is fully substantiated by the contributions of Melville, Mayo and others in the next group. Solomon has attempted to use Dewar's π-complex picture in the study of radical reactions and finds the 'steric effect' of bulky groups an obstacle for generalisations. He is able, however, to successfully use the idea in a study of rubber-like products.

The present discussion maintains the tradition that one has come to associate with 'Discussions of the Faraday Society' and is suggestive of further fundamental work in a fruitful field.

S. V. ANANTAKRISHNAN.

SCIENCE NOTES AND NEWS

Association of Scientific Workers of India

The second Annual General Meeting of the Association of Scientific Workers of India was held on January 4, 1949, with Dr. T. N. Seth, Professor of Medical Chemistry, Medical College, Patna, in the chair. The following National Executive of the Association has been elected for the year 1949. *President*: Pandit Jawaharlal Nehru; *Vice-President*: Dr. B. C. Guha; *General Secretaries*: Dr. P. K. Kichlu; and Mr. C. R. Mitra; *Joint Secretary;* Mr. S. Bhattacharji; *Treasurer*: Dr. D. V. Karmarker; *Members*: Dr. A. N. Bose, Dr. S. Banerji (Calcutta), Mr. Bharat Bhushan, Mr. S. K. Mohindra (Delhi), Dr. T. D. Patel, Maj.-Gen. S. S. Sokhey (Bombay), Mr. N. R. Srinivasan (Bangalore), Mr. A. C. Sen (Patna), Mr. S. C. Roy (Lucknow), Mr. H. Hasan (Aligarh), Dr. B. Prasad (Cuttack), and the Secretaries of the Branches at Delhi, Calcutta, Bombay, Bangalore, Lucknow, Raniganj, Naihati and Patna.

Admission to Educational Institutions Abroad

The Government of India have had under consideration for some time past the problem of ensuring that Indian students proceeding abroad at their own expense benefit to the fullest possible extent from the educational opportunities provided by institutions abroad.

For the purpose of imparting information and guidance to students wishing to proceed abroad, the Government of India have set up an Overseas Information Bureau in the Ministry of Education. Besides this Bureau, there are at present a number of University or Provincial Students' Advisory Bureaux in the Provinces and the States.

Students wishing to proceed abroad at their own expense are required to contact for information, etc., the nearest advisory organisation in their Province or State and also submit their applications for admission to that Bureau for onward transmission to the Ministry of Education, Government of India. Students of the areas in which there are no such advisory organisations may, however, apply direct to the Ministry of Education.

It is desirable that only students with good academic qualifications should seek admission in foreign universities.

Atomic Energy Commission—India

The first conference of the Atomic Energy Commission met today at New Delhi to draw up a syllabus for the teaching of nuclear physics, chemistry and mathematics to the University students to equip them for research work in atomic energy.

The conference was attended by Dr. H. J. Bhabha, Dr. S. S. Bhatnagar, Dr. S. N. Bose and Dr. R. S. Krishnan, members of the Atomic Energy Commission and 23 other scientists who represented 14 Indian universities and scientific institutes.

Meteorological Mission to Himalayas

With a view to studying meteorological conditions associated with atmospheric disturbances in the Ladakh Valley and the adjoining Himalayan regions, in order to make flying safe in these regions in the cold weather, an RIAF meteorological expedition led by Flying Officer K. Chandra, recently left for Ladakh.

The party will study conditions in these regions and particularly those at altitudes ranging from 18,000 to 20,000 feet above sea level. Its medical research team, under the supervision of Major S. L. Kalra, will study medical problems connected with high-altitude

flying, the depth of air pressure at different heights and how it affects the human body.

This is the first expedition of its kind to undertake a meteorological survey of the Himalayan regions in winter. If successful It will have a far-reaching effect, as an all-weather route through these regions will bring these remote Himalayan regions in closer contact with India, thus opening a new chapter in cultural intercourse between the land where Buddhism flourished and the land that gave birth to it.

The expedition has been made possible by the untiring efforts of Air Commodore A. M. Engineer and Wing Commander H. Moolgaonkar.

Agricultural Meteorology and Hydrology

The Asian Conference of Weather Experts decided at one of its sittings to appoint two Sub-Commissions for Agricultural Meteorology and Hydrology to work in close collaboration with the permanant Commissions of the International Meteorological Organisations and to advise the Member States in this region.

The Sub-Commission on Agricultural Meteorology will have representatives of the USSR, Japan (Scap), India, Pakistan, Indo-China, Siam and Indonesia as members. India's representative, Dr. L. A. Ramdas, will be the Chairman.

The Sub-Commission on Hydrology will have as its members representatives of India, Pakistan, the USSR, China, Siam, Indo-China and the Philippines.

Both the Sub-Commissions will have the power to co-opt additional members, if necessary.

The Conference also discussed the question of standardisation of meteorological instruments. It was felt that Asia should be subdivided into four regions for purposes of inter-comparison of standard barometers, etc.

Co-ordination of Plant Protection Work in India

A meeting was convend on 12th January 1949, under the ægis of the Ministry of Agriculture, Government of India — and under the Chairmanship of Sardar Datar Singh—Vice-Chairman of the Indian Council of Agricultural Research,—at which important decisions were taken principally on four aspects of plant protection work in India.

(1) Building up of plant protection organisations—Every Province and State should have adequate plant protection staff; the central Directorate of Plant Protection, Quarantine and Storage should be adequately staffed to advise and assist the Provinces and States and procure for them insecticides, fungicides and mechanised equipment.

(2) Central Pool.—The Government of India should maintain a central pool of plant protection power-operated machinery in 3 centres, namely Asansol, Ajmer and Nagpur, to serve all parts of the country and the various important insecticides and fungicides and machinery should be rapidly tested by a central organisation to gauge their efficacy in dealing with particular pests and diseases.

(3) Training of personnel.—The Provincial and State Governments having well organised Departments of Agriculture, should train their personnel and that the centre should train the rest of the personnel from other areas not having such departments.

(4) Quarterly Bulletin.—The Plant Protection Adviser should issue a quarterly Bulletin which may later be developed into a monthly bulletin giving an all-India appreciation of the pest and disease situation for the use of plant protection workers.

Indian Botanical Society

At the Annual Meeting of the Society held at Allahabad, the following Office-bearers were elected for the year 1949:—

President: Prof. G. P. Majumdar, Calcutta.

Vice-Presidents: Dr. A. C. Joshi, Hoshiarpur Prof. M. O. P. Iyengar, Madras.

Councillors: Prof. Birbal Sahni, Lucknow. Dr. R. H. Nirula, Nagpur. Prof. Shri Ranjan. Allahabad. Prof. P. Maheshwari, Dacca; Dr. L. Narayan Rao, Bangalore; Prof. Y. Bharadwaja, Jodhpur. Prof. M. Sayeed-ud-din, Hyderabad; Prof. K. C. Mehta, Agra. Dr. B. P. Pal, Delhi; Dr. R. K. Saksena, Allahabad.

Editorial Board: Prof. G. P. Majumdar (Chief Editor), Calcutta; Prof. P. Parija, Cuttack; Prof. A. C. Joshi, Hoshiarpur.

Dr. T. S. Mahabalé. Royal Institute of Science, Bombay-1, and Prof. S. P. Agharkar, Law College Building, Poona-4, continue to be the Secretary and the Treasurer and Business Manager of the Society respectively.

Unesco Grant to Indian Chemical Society

The Secretary of the Indian Chemical Society is glad to announce that Union Internationale d'Histoire des Sciences has, out of their subscription from Unesco, made a contribution of the sum of 500 dollars towards the preparation of the History of the Chemistry in Ancient and Medieaval India undertaken by the Society. The Society has also approached the Govt. of India for a generous contribution for the same purpose.

Editor: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc.
120-49 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore.